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Topics of the Month

Fuel economy pays

FOR the past few years hardly an autumn has passed without serious governmental warnings of a winter shortage of coal. In his first speech to the new Parliament the new Minister of Fuel had to copy his predecessors and issue the usual gloomy forecast of a dearth of coal in the coming winter. Attempts are to be made to import American coal, but less than usual is expected. Furthermore, it is expected that in the next twelve months the number of miners will decrease by 10,000 and that a deficit of about 5,000,000 tons of coal is in prospect.

Against this depressing background comes a new booklet, 'Fuel Economy Pays,' published by the Federation of British Industries (2s.). Here it is stated bluntly that industry must look primarily to economy in the use of fuel rather than to greater supplies to increase production. This statement has been made so many times that it is now platitudinous. Nevertheless, it is true. Industry largely has the remedy for the coal shortage in its own hands. It will be a slow process to convert every executive, every manager and every foreman to this view, but unless this is done we must look forward to endless anxiety about coal supplies. Because fuel economy is so vital every means to bring it about is worth full publicity and it is for this reason that we commend to everyone in the chemical industry this new and admirably concise booklet.

It is divided into three sections. Section 'A' deals with common faults in boiler operation and their remedies. It covers hand and automatic firing and control of air for combustion. Methods of eliminating losses due to faults in brickwork, to poor heat transfer or inefficient operation are discussed and possibilities of substantial savings are shown. Section 'B' deals with a much-neglected field for improvement—the use of instruments for measurement and control. Section 'C' deals with the efficient use of heat. An elementary explanation of the properties of saturated steam is included to underline the waste caused by the use of needlessly high pressures for process work. Thermal insulation of buildings and plant is discussed and it is emphasised that there is a good supply of the necessary materials. The section concludes with recommendations for the recovery of heat contained in process effluents, vapours and condensate, and the exhaust gases and cooling water of auxiliary oil engines. Although the booklet is short it includes details of several publications giving further relevant information.

Fuel economy can be made to work if only managements will take the necessary trouble. Here are some examples : Improved methods of operation and control of draught on the boiler plant at a dye works led to a saving of 2 to 3 tons of coal from a weekly consumption of 20 tons. A brewery modified its two Lancashire boilers, improved insulation and instrumentation and saved 5 tons from a weekly consumption of 45 tons. A tannery saved 200 tons of fuel a year by improving insulation, installing reducing valves and steam traps and improving combustion efficiency. An engineering firm saved more than £4,000 p.a. on its fuel and labour bill by eliminating wasteful heating of coal-tar fuel storage tanks and supply lines at a cost of only £400. A thermostat fitted to the heating system of a works canteen at a cost of £15 saved 16 tons of fuel p.a.

There can be few firms where similar economies cannot be made. The chemical industry should lead the way in fuel economy, for to it coal is not only a fuel but a basic raw material.

Rebirth of German nitrogen industry

FOLLOWING the lifting of the restrictions on production by the West German nitrogen industry, efforts are now being made to make good as speedily as possible war damage and losses resulting from dismantling. Originally, the industry's production capacity had been limited by the occupying powers to 400,000 tons a year. This figure was raised to 455,000 tons under the so-called 'Petersberg Agreement.' The lifting of the restrictions on various chemical industries was announced by the Allied Powers earlier this year ; the law confirming this action and giving details of the relaxations was published several months ago by the Allied High Commission.

It is not intended to construct any important new facilities for the time being, but rather to reactivate existing plant. Production is to be restarted by the following units : the Primary Nitrogen Works, Oppau, belonging to the Badische Anilin- und Sodafabrik (which used to be the leading producer, with a capacity of 350,000 tons p.a., which was, however, reduced to 150,000 tons after the war) ; the calcium cyanamide installations of the Lonza works in Weil ; the calcium cyanamide works, Trostberg ; the processing plant for primary ammonia in the former I.G. Farben works at Hoechst (now Farbwerke Hoechst) ; and the primary nitrogen installations of the Hibernia Co. of Ruhrchemie, of Bergbau A.G. Ewald Koenig Ludwig and of the Gewerkschaft in Knappsack. Also to be drawn into the plan are Ruhr coking plants and the Wesseling plant of the Union Rheinische Braunkohlen-Kraftstoff A.G. near Cologne. It remains to be seen how much gas can be made available by the coal industry for these plants.

As to consumption, the O.E.E.C.'s and the West German Government's plans provide for the use of 450,000 tons of nitrogen by West German agriculture in 1952-53, compared with 330,000 tons in the fertiliser year 1949-50. Private experts express the view that a consumption of 550,000 to 600,000 tons is required for maximum agricultural production.

They hold that increased use of nitrogenous fertiliser, as well as of phosphorus, and lime and potash fertilisers could raise annual West German grain production by 5,000,000 tons, fodder beet production by 13,000,000 tons and milk production by 4,000,000 tons.

In East Germany, annual production of primary nitrogen is now in the region of 250,000 tons p.a.

New standards for hydro-extractors

ORIGINALLY published in 1938, the British Standard No. 767 on hydro-extractors has been revised and reissued under the title 'Hydro-extractors and Centrifugal Machines.' This alteration in the title has been made in order to avoid confusion.

The revised standard covers hydro-extractors and centrifugal machines having vertical, horizontal or inclined shafts, running at speeds from 400 to 3,000 r.p.m., for use in laundries, textile and other industries. It sets down certain principles for the design, construction and operation of hydro-extractors and centrifugal machines used for the extraction of liquids from solids, but it does not apply to high-speed centrifuges or separators used, for example, in oil or cream separation plants. The standard covers such matters as details of basket construction, quality of materials, safety designs, tests and marking. In the appendices it gives information on operation and maintenance, as well as detailing information to be supplied with the enquiry or order.

Additionally, the method of calculating the stresses in the basket shell and hoops has been simplified as far as possible, and allowable stresses for the constructional materials have been brought into line with current practice. The standard costs 2s. 6d., post free, from the British Standards Institution, London.

Saving scarce materials

ONE of the consequences of rearmament has been to aggravate seriously shortages of certain materials needed both for civilian and military consumption. While world production of goods has been rising steadily over recent years, the production of basic raw materials has not been increased at a corresponding rate. Some materials are becoming increasingly difficult and costly to win and, in some cases, world reserves are rapidly diminishing. While efforts are being launched to expand the production of numerous scarce raw materials, these are mainly long-term measures. They are, moreover, handicapped by shortages of labour, productive equipment and capital resources. Short-term policy, therefore, must be to encourage the conservation and efficient use of the scarce materials.

British industry has had a good deal of experience, both during and after the war, in measures for economising in scarce materials. Nevertheless, it was thought advantageous for the Anglo-American Council on Productivity to send a team to the United States to report on what was being done there and to advise how any economy measures being taken there might help British industry. The team concentrated on the engineering and allied industries and this resulted in the survey being concerned almost wholly with scarcity in supply and economy in the use of metals. The results of this survey have now been published in a report on saving scarce materials recently published by the Council.

While the extent and incidence of shortages differ in detail from those current in Britain, much of the information collected is of direct value to U.K. industry. Of the commoner metals, aluminium, copper, nickel, silver and zinc are listed as in very short supply in both the U.S.A. and the U.K. The use of plastics as alternatives for non-ferrous and other metals was widely discussed. For technical and supply reasons it was generally considered that plastics could not be automatically used in place of metals, although there were many applications where they were more effective owing to such properties as lightness or ease

of production. There was no unanimity of opinion about shortages of plastics and there seemed to be considerable uncertainty about the immediate and future supply situation.

Recommendations made in the report include the following. Steel conservation committees in the U.K. should give renewed attention to the properties of lower alloy-content steels and to special techniques for hardening and heat treatment as at present employed on a substantial and increasing scale in the U.S. Conservation measures being taken in the U.S. with copper, nickel, lead and tin should be further studied by British industries, including those manufacturing metal containers and heat exchangers. The redesign of manufactured products with particular regard to the conservation of scarce materials is recommended as a continuous activity.

One interesting point made was that three new British techniques were of considerable interest to American industry and should be made more widely known in the U.S. These are (1) electro-deposition of combinations of tin-zinc and tin-nickel, (2) use of ceramic-tipped cutting tools and (3) use of precision-cast milling cutters. The report is available from the Anglo-American Council on Productivity, London, price 2s., post free.

How much dearer are raw materials?

EVERY chemical manufacturer is only too sharply aware of the alarming increases in the prices of raw materials which have afflicted him over the past few years and particularly within the past twelve months. An overall picture of these increases is published in the November issue of the *I.C.I. Magazine*. Imperial Chemical Industries Ltd. is such a vast organisation that it buys almost the whole range of chemical raw materials. Thus, these details from its central purchasing department, which bought £40,000,000-worth of raw materials in 1950, are representative of the whole chemical industry. Here is the index which tells the whole story :

Material	1939	*Mid-1950*	*Mid-1951*	*Price increase between mid-1950 and mid-1951*
Minerals (*e.g.* sulphur, pyrites, phosphate rock, etc.)	100	172	219	27%
Inorganic chemicals	100	250	310	24%
Organic chemicals (*e.g.* alcohols, solvents	100	227	411	81%
Coal-tar products (e.g. benzol, naphthalene, etc.)	100	172	202	17%
Oils, fats, etc. (*e.g.* castor, linseed, etc.)	100	263	479	82%
Copper	100	323	477	48%
Aluminium	100	119	133	12%
Other non-ferrous metals	100	400	804	101%
Coal	100	263	282	7%
Coke	100	263	284	8%
Greycloth (for *Rexine* and *Vymide*)	100	500	840	68%
Rubber	100	204	571	180%
Steel sheets (for making drums)	100	189	194	3%
Weighted average of all I.C.I. raw materials	100	272	403	48%

Against the terrific rise in the prices of rubber, oils and fats, and organic chemicals, the modest increases in the prices of aluminium, sulphur, pyrites, phosphate rock, coal and coal tar products stand in remarkable contrast.

It is noteworthy that the materials which have increased most in price are products which enter most into international trade and which have thus been most susceptible to the panic buying for stockpiling which followed the outbreak of the Korean war. In the organic chemicals group, ethyl alcohol and solvents have become expensive because of the huge American demand for alcohol for synthetic rubber manufacture. Oils and fats have been more or less scarce since the end of the second world war and the Korean war has accentuated their scarcity and raised their prices still higher.

It is fortunate for the British chemical industry that the country can produce its own coal and thus control the price. If the price of this basic chemical raw material were to get out of hand there would be a poor prospect of keeping costs within endurable limits.

Swiss chemical industry's future

THE chemical industry of Switzerland is highly artificial in that it has grown and flourished in spite of the absence of indigenous supplies of basic raw materials like coal, petroleum, sulphur and pyrites. All its raw materials must be imported and the only indigenous ingredients of its chemical exports—dyes, drugs, perfumery, etc.—are the skills, ingenuity and resourcefulness of Swiss chemists and chemical engineers. The industry is thus extremely sensitive to world prices and supplies of raw materials and to technological and commercial trends in countries blessed with domestic sources of raw materials.

In his address to the annual general meeting of the Schweizerische Gesellschaft für Chemische Industrie, held recently at Montreux, the president, Dr. A. Wilhelm, examined current international trends in chemical industry and their effects upon his own country's industry. According to him, the Swiss industry stood at the greatest disadvantage in the face of the rapid development of petroleum and natural gas as sources of chemicals. Switzerland was even more remote from supplies of petroleum and natural gas than from supplies of coal and this fact would gravely handicap the industry in the future. Another threat to Switzerland was the expansion of the influence of the American chemical industry in Europe and elsewhere. Not merely single processes were being licensed, the Americans were exporting whole manufacturing units, including the know-how of erection and operation. This trend was being accelerated by the Marshall Plan, the Organisation for European Economic Recovery and the North Atlantic Treaty Organisation.

The recovery of the German chemical industry would also adversely affect the Swiss industry. The lifting of the ban on the manufacture of nitrogen, chlorine, aluminium and synthetic rubber, and on the use of the Fischer-Tropsch synthesis, was providing the German industry with a new impetus. Further, Germany was now a member of the European Payments Union, which facilitated exports to other European countries. Dr. Wilhelm also pointed out that Japan had reappeared as a supplier of chemicals, mainly dyestuffs, in certain European countries.

Competition from eastern European countries would also increase during the next few years. Chemical enterprises in eastern Europe were expanding and technical experience was being exchanged between the chemical industries of East Germany, Czechoslovakia and Poland under Russian control.

To counteract these adverse trends, Dr. Wilhelm urged the establishment of a Swiss National Fund for the Promotion of Scientific Research, as suggested by leading Swiss industrialists to the Government a few months ago. The revision of Swiss patent laws to meet modern conditions in industry, particularly the chemical industry, was also strongly advocated in the interest of economic development.

Dr. Wilhelm's pessimistic survey should not be taken as heralding the immediate eclipse of the Swiss chemical

industry. Earlier this year it was reported that Swiss exports of chemicals and pharmaceuticals had reached an all-time record and included among the most important customers were both the U.S.A. and Germany (see INTERNATIONAL CHEMICAL ENGINEERING, July 1951, p. 340).

International trade in fertilisers

TO help promote international trade in fertilisers, the Sub-Committee on Fertilisers, Fungicides and Insecticides of the Organisation for European Economic Co-operation has compiled and published a book of excerpts from the fertiliser trade regulations of the 18 countries which are members of the organisation. In thus spreading knowledge of the more important conditions under which fertilisers may be produced, imported and sold in the different countries the O.E.E.C. has two main objects. The first is to encourage international trade in these essential food-producing chemicals. The second is to help governments who may envisage new laws on this subject or the amendment of existing laws. It is also hoped that at a later stage it will be possible to form certain recommendations in regard to general rules that could be adopted by all countries, in order to facilitate further international trade in fertilisers.

The book is an outstandingly useful document for the fertiliser trade in the O.E.E.C. countries, *i.e.* Austria, Belgium, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Sweden, Switzerland, Trieste, Turkey and the United Kingdom. It is interesting to note that four countries —Sweden, Austria, Iceland and Turkey—have no fertiliser regulations at all. This is perhaps not surprising in the case of the last two countries, which have little or no fertiliser industry themselves, but one would have thought Sweden and Austria would have had regulations. In Sweden, apparently, the only influence exercised in this field is that of the Royal Board of Agriculture, which institutes rules for the analysis of fertilisers in State agricultural laboratories and Government-subsidised agricultural laboratories. In Austria, an order of 1925 based on a federal law of 1923 and amended in 1932 dealing with illegal competition, was abrogated after the institution of German legislation and was not reintroduced after 1945, it having become obsolete. However, a new law is expected to be laid before the Austrian parliament shortly.

The book reveals some interesting contrasts in fertiliser legislation. For instance, in Norway and Denmark, the content of the three main plant nutritive elements must be calculated as N, P, K, whereas in other countries N, P_2O_5 and K_2O as the basis for indications of the quantitative and generally also for the qualitative content is required by law or in common use. It appears, however, that in Sweden the same indication is used by general understanding as in Norway and Denmark, though without authority of law. It should, however, be noted that in the Netherlands for mixed fertilisers the qualitative (not the quantitative) indications for the three plant nutrients must be expressed by N, P, K.

Solubility in water appears to be required by law for phosphoric anhydride accounted for in superphosphates in Norway, the United Kingdom, Ireland, the Netherlands, Belgium, Switzerland and Portugal. The content of the plant nutritive elements of fertilisers or their minimum content is prescribed by law in Belgium, the Netherlands, Switzerland, Portugal and Italy. Limits of variations for the most commonly used fertilisers are also fixed by regulations in a number of countries and it is noted that they differ considerably.

Limits for certain plant poisons which may not be exceeded are fixed by the Danish regulations. In the Netherlands and in Switzerland the content of chlorine in certain fertilisers is limited. In the United Kingdom and in the Netherlands the content of free acid in ammonium sulphate must be indicated. In Belgium, phosphate fertilisers other than basic slag exceeding a content of 10% sesquioxide must carry an indication ' iron '—or ' aluminium phosphate.'

French paint production below capacity

THERE are about 500 relatively important producers of paints, varnishes and pigments in France and numerous smaller ones. Total output in 1950 was 170,600 metric tons, compared with 142,700 tons in 1938. The industry recovered rapidly after World War 2, and production in 1947 exceeded the pre-war average by about 20%. A significant shift in the type of paints produced occurred in 1947 and 1948, when oil paints rose from 8,600 tons to 21,965 tons, owing chiefly to the easing of the supply and price situation for drying oils. Production of synthetic resins, enamels and varnishes (without oil) dropped from 22,205 tons in 1948 to 8,215 tons in 1949.

A record output of 197,500 tons of all types of paint was reached in 1948, when stocks were being replenished, but production levelled off to 174,800 tons in 1949 and 170,600 tons in 1950. Output in the first four months of 1951 was at an annual rate of 185,700 tons, but the industry anticipated a decline in production and sales in the remaining months of the year. Reasons for the expected decreases are growing costs of raw materials, the difficulty of obtaining them, lower consumption resulting from high prices for finished products and lack of purchasing power. The unusually large post-war market for paints and varnishes stimulated an expansion in capacity, which is now approximately 350,000 tons annually. Only about 60% of this capacity is being utilised.

Institute of Metal Finishing

AT the last annual general meeting of the Electrodepositors' Technical Society a resolution was passed that application should be made for official incorporation and for permission to adopt a new title embracing metal finishing generally, excluding only vitreous enamelling. As a result, the new title by which the Society will henceforth be known is the Institute of Metal Finishing incorporating Electrodepositors' Technical Society Ltd. The change has been made in accordance with the general policy of the Society to extend its field beyond electrodeposition processes to include metal finishing generally, with which most of its members are closely concerned. The original aims of the Society, namely to promote the study of, and disseminate information on, electrodeposition and cognate processes as widely as possible, are in no way affected and will, in fact, be pursued as vigorously as ever. This widens the sphere of interest and will bring with it a corresponding benefit to the membership.

'I.C.E.' January — *The main article will be an illustrated description of the new chemical engineering laboratories at the Delft Institute of Technology, Holland.*

Lubricants Plant Rebuilt

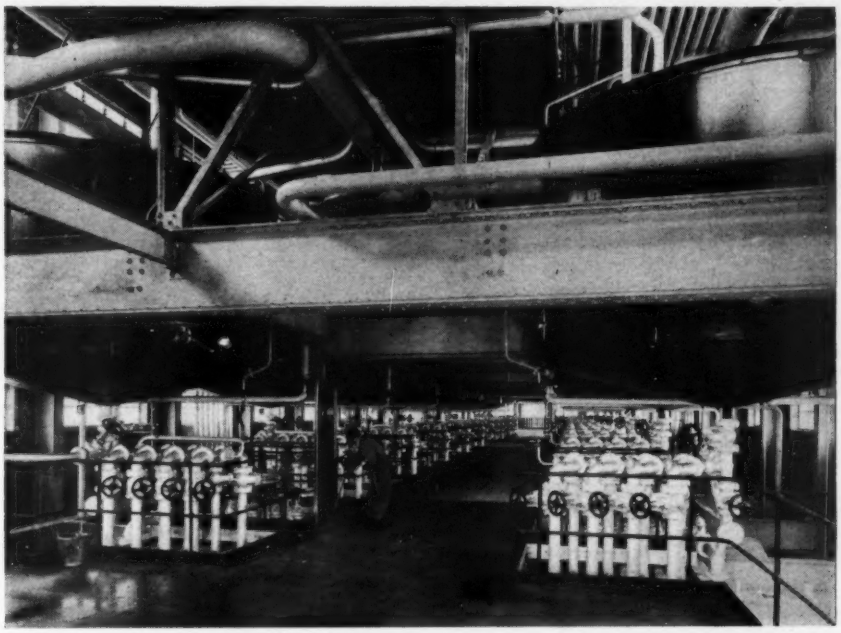
In 1938 the United Kingdom's consumption of lubricating oils and greases amounted to 560,000 tons ; today it is 800,000 tons. The reconstruction of the Shell-Mex and B.P. Ltd lubricants plant at Barton, near Manchester, is a step towards meeting the higher demand by increased domestic production. The blending of oils is essentially the purpose of the reconstructed plant and considerable success has been achieved in making the process automatic, in spite of the fact that the demand is for many diverse blends rather than a large tonnage of a few products. With the new facilities, six blends of lubricants can be produced simultaneously from a range of some 50 basic oils or additives by an operator at a central control point.

THE reconstructed lubricants plant of Shell-Mex and B.P. at Barton, Manchester, covers 22 acres and is divided by the main road through Trafford Park into a north side—essentially a factory area producing lubricating oils and greases—and a south site which is mainly a 21,000,000-gal. tank farm incorporating a fuel oil supply depot with repair facilities for road and rail vehicles and constructional and maintenance engineering shops.

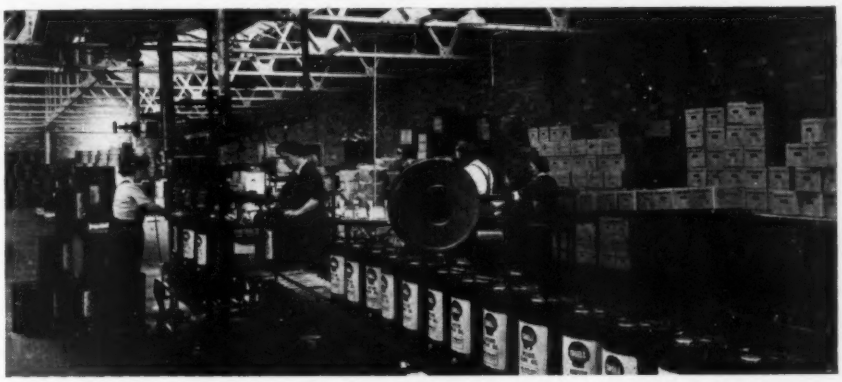
The north site, which contains new producing plant, lies on the Manchester Ship Canal. It has a tanker jetty from which a series of 8-in. overhead pipelines convey oil from ocean-going tankers or smaller craft, operating from the nearby Stanlow refinery and other British refineries to the tank farm on the south site, whence the basic oils used in the manufacture of lubricating oils and greases are pumped as required to the factory area.

The north site consists mainly of a new plant for blending, packaging and dispatch of lubricating oils, including facilities for bulk loading of road wagons and railcars ; plant for preparing, reconditioning, painting and storing all package containers for the factory's products, ranging from 1-lb. tins to 40-gal. or 400-lb. barrels ; plant for manufacturing, packaging and dispatch of lubricating greases ; and an administration block, including offices, laboratory, pilot experimental grease plant, boilerhouse and electrical sub-station, and canteens and cloakrooms.

The plants are linked by Lamson pneumatic tubes for speedy conveyance of samples and documents, by an internal telephone system, by mechanical conveyors, by oil, steam and air pipelines and by roads and railways.



Delivery lines leading from the blending tanks to the storage tanks serving the filling points.



Operators filling 5-gal. drums of lubricating oil and (*right*) packing 1-pint containers. An electrical machine automatically ensures that the drums are filled with the correct quantity.

Lubricating oil plant

A notable feature of the reconstructed plant is the vertical system employed for the blending of lubricating oils. This plant is housed in a structure 80 ft. high, at the top of which are some 30 tanks fed with the various component oils by pipeline from the tank farm. In the blending of the different grades of lubricating oil the components are fed by gravity into the appropriate tank, where thorough mixing is effected ; individual tank feed for fats and special additives are raised from ground-floor storage for this purpose.

A centralised arrangement of pipe terminals, valves and pneumatic measuring instruments permits an operator at a central control panel to make simultaneously six blends drawn from a range of some 50 basic oils or additives. There are four such central points, with provision to double them if more are required. This combination of gravity feed and central control, which has replaced a more dispersed and expensive system of tanks and pumps on one level, is as near to fully automatic blending as is practicable in a trade which provides many diverse blends rather than a large tonnage of a few grades.

From the lubricating oil plant most of the blended oils are piped to the package plant, the filled and labelled drums and barrels being taken forward by conveyor

to the fork-lift truck operating area, whence they are delivered to storage or dispatched direct by road, rail or water.

Grease plant

The economics of grease manufacture make it desirable to centralise production for as large a market as possible. Barton is a suitable location for such manufacture because it lies on the Manchester Ship Canal, which facilitates both the importation of the basic oils and the exportation of the finished products. Moreover, Manchester is the heart of one of the principal manufacturing regions of the country, where half the population of Britain live and work within a radius of 100 miles.

The grease plant which has not been reconstructed is capable of producing between 15,000 and 20,000 tons of grease a year, and its output will soon be substantially increased by advanced mechanisation.

All stages of manufacture of these liquid and semi-solid lubricants at Barton are subject to the rigorous control of the chief chemist, who has a staff of assistant chemists engaged on routine tests of quality.

In addition to the rebuilt and well-equipped laboratory there is a pilot plant where investigational work and the small-scale production of grease for special requirements can be undertaken.

New Metals and Alloys

A GLIMPSE of future developments in metallurgy was given by Prof. A. G. Quarrell of Sheffield University in an absorbing lecture on newer metals and alloys given at the recent annual meeting of the British Association. Introducing his subject, Prof. Quarrell acknowledged the help of the engineer in modern metallurgy by pointing out that many operations in the production and working of metals are only possible because the engineer provides the metallurgist with the powerful and sometimes elaborate machines that are required. It is equally true to say that many of the achievements of modern engineering would not have been possible had not the metallurgist developed new and improved alloys with properties suitable for the particular application. Whereas engineers at first based their designs upon known alloys, they now tell the metallurgist what combination of properties is required to permit optimum, or at least efficient, performance of a given machine. The metallurgist is by now quite familiar with the technique and knows only too well that as soon as he has provided what he was asked for, more exacting demands will be made. Much of the metallurgical activity of this country is, in one way or another, concerned with meeting such demands.

For most of the five or six thousand years that metals have been used by man, metallurgy has been an art rather than a science and new alloys have resulted from chance observation rather than from deliberate effort. The last few years have seen vast strides in our understanding of the theory of alloys, but unfortunately the alloys which are most important technically are extremely complex and industrial practice still outstrips theoretical understanding. As a result, alloy development is still largely empirical and the rapidity with which existing alloys are improved and new alloys developed is due mainly to the magnitude of the effort being made and to the skill of the metallurgist in exploiting to the full any beneficial effects he observes as a result of changes in composition or in heat treatment.

The needs of the aircraft industry for alloys of high strength-to-weight ratio suitable for air-frames and for alloys capable of withstanding high stresses at elevated temperatures in aero engines have provided the incentive for the steady improvement of light alloys and of the special alloy steels. High-strength aluminium alloys of the aluminium-zinc-magnesium-copper type are the most recent in the line of descent from Wilm's duralumin and form a large part of most modern aircraft. Greatly improved properties, coupled with the low density of magnesium, have become available in the last few years with the introduction of the magnesium-zirconium-zinc alloys ; the zirconium exerts a powerful grain-refining effect, reduces the microporosity which was such an undesirable feature of earlier alloys and facilitates both hot and cold working.

Alloys for high temperatures

Alloys suitable for use at elevated temperatures, as in the gas turbine, have been the subject of much discussion recently and, on the whole, the tale is one of steady improvement of known alloys rather than of the discovery of alloys of quite new types. Austenitic steels, particularly an alloy containing nickel, chromium, cobalt, tungsten, molybdenum and columbium, have given successful service as gas turbine discs under conditions of high stress and high temperature. Ferritic steels have been continuously improved and there are now alloys with creep and scaling resistance almost approaching those of the austenitic steels and much more economic because of their lower alloy contents. Alloys based on the 80/20 nickel-chromium alloy, with the addition of titanium and aluminium, have proved most successful for use as gas-turbine rotor blading, and continuous research by a large team has enabled the maximum working stress and temperature of such alloys to be raised repeatedly.

Copper alloys

Copper alloys are also affected by the requirements of the gas turbine. Light alloys are extensively used for compressor blading, but the higher working temperatures involved in contemporary design is causing special interest to be shown in the complex aluminium bronzes. The single-phase aluminium bronzes are similarly of interest in connection with the heat exchangers which form an essential part of long-life gas turbines suitable for marine or land installations.

Full information has recently been published concerning the copper-nickel-iron alloys that were developed to meet the exacting requirements of the Navy at war. Copper-base alloys containing up to 10% nickel and up to 2% iron can be worked almost as readily as copper by the techniques used by the coppersmith and yet have excellent resistance to the impingement type of corrosion attack caused by sea water containing entrapped air. These alloys have already shown their value for auxiliary piping in ships and, in the U.S.A. at least, they are being advocated for use as condenser tubes.

Cast iron

Systematic study of the effect of alloying additions upon the properties of cast iron has considerably extended their field of usefulness, but even more important, potentially, is the development of nodular cast iron which has resulted from a scientific study of the mode of graphite formation. By adding to the ladle small amounts of cerium or magnesium the iron can be made to solidify with the graphite in nodular instead of flake form, and the mechanical properties are comparable with those of steel, although the excellent casting characteristics of normal cast iron are retained.

Some of the metals hitherto considered only as alloying elements are becoming of increasing interest as the possible bases of new systems of alloys. Thus, certain chromium-rich alloys have good creep properties at temperatures as high as 900 or 1,000°C., although their practical use is prevented by their extreme brittleness at ambient temperatures. Again, in recent years, ductile titanium has become available in reasonably large quantities for the first time and much effort is now being devoted to assessing its potentialities. Titanium is relatively light—it has a specific gravity of 4.5—its resistance to corrosion by chloride solutions is excellent and its tensile strength is greater than that of mild steel and can be further increased by alloying. Large quantities of titanium ores are available and, if improved large-scale methods of extraction can be devised, a new and important industry will almost certainly grow up, helping to relieve the shortage of those metals that we have for so long taken for granted.

Japan's Sulphate of Ammonia Industry

The sulphate of ammonia industry of Japan is the biggest and most important in Asia. Since its birth just 50 years ago, the industry has raised its output to 1,500,000 metric tons p.a. and is now planning to increase capacity to 2,600,000 tons p.a. by July 1952. Technically this industry is based almost completely on foreign patents and an unusually high proportion of production is by the electrolytic process. Here is a survey of the technological and economic aspects of this important fertiliser industry.*

THE production of sulphate of ammonia in Japan began in 1901 when a small amount was obtained as a by-product of coal used for gas production. In 1910, the calcium cyanamide production process began. Even then a large portion of the total requirements had to be imported from abroad. With the adoption in 1924 of the direct synthesis process, the sulphate of ammonia production increased steadily and at the outbreak of the recent war Japan ranked with Germany as the world's largest producer of this material, reaching the stage of almost complete self-sufficiency. Thereafter production declined, but later increased again to 1,502,000 metric tons in 1950, a record output, with capacity actually amounting to 2,090,000 tons.

In Japan the consumption of nitrogen fertiliser is about 50% of the total consumption of the three elements, nitrogen, phosphorus and potassium, with sulphate of ammonia accounting for some 80% of the nitrogen. In contrast, consumption in the U.S. is in the proportion of 26% nitrogen, 48% phosphorus and 26% potassium with sulphate of ammonia accounting for only about 25% of the nitrogen consumed. In 1950, U.S. production of nitrogen was 1,005,000 metric tons, compared with the Japanese total of 386,000 tons.

The production of sulphate of ammonia in Japan is carried on almost exclusively by companies specialising in fertiliser manufacture. Of the various kinds of fertiliser produced by the 14 Japanese companies in this field, sulphate of ammonia accounts for

*Abstracted from *Survey of Japanese Finance and Industry*, 1951, 3 (5).

PRINCIPAL JAPANESE MANUFACTURERS OF SULPHATE OF AMMONIA

Name of company	*Authorised capital stock (¥ 1 million)*	*Names of factories*	*Date of commencing operations*	*Productive capacity 000's tons*		*Process used*	*Percentage of sulphate of ammonia to total production of fertilisers in 1949*	*Main products*
				September 1950	*July 1952 (estimate)*			
Toyo Koatsu Kogyo K.K.	450	Sunakawa	1946	G 142.0	G 204.0	Claude	% 70	Sulphate of ammonia
		Hikoshima	1922	G 19.7	G 19.7			
		Omuta*	1932	G 250.0	G 250.0			
Nitto Kagaku Kogyo K.K.	500	Hachinoe	1940	E 27.0 G 47.0	E 27.0 G 73.0	I.G.	75	,,
		Yokohama	1939	G 85.0	G 114.0			
Tohoku Hiryo K.K.	60	Akita	1940	E 19.0 G 43.0	E 38.0 G 43.0	New Uhde	100	,,
Nippon Suiso Kogyo K.K.	60	Onahama*	1940	G 81.1	E 12.4 G 86.1	,,	86	,,
Showa Denko K.K.	550	Kawasaki	1931	E 250.0	E 250.0 G 60.0	Tokyo Engineer'g Experiment Laboratory	30	Calcium cyanamide (40%)
Nissan Kagaku Kogyo K.K.	500	Toyama	1928	E 93.1 G 67.8	E 127.1 G 95.6	Fauser	24	Super-phosphate of lime (56%)
Toa Gosei Kagaku Kogyo K.K.	300	Nagoya	1934	E 58.4 G 47.5	E 58.4 G 82.6	Uhde I.G.	50	Sulphate of ammonia
Tokai Ryuan Kogyo K.K.	85.5	Yokkaichi†	1946	E 44.2	E 44.2 G 93.0	Fauser	100	,,
Befu Kagu Kogyo K.K.	60	Befu	1938	G 72.7	G 92.0	I.G.	97	,,
Ube Kosan K.K.	300	Ube	1934	G 230.0	G 280.0	Fauser	35	Coal (43%)
Nisshin Kagaku Kogyo K.K.	1,000	Niihama*	1931	E 25.0 G 225.0	E 2.50 G 308.0	N.E.C.	45	Sulphate of ammonia
Nippon Kasei Kogyo K.K.	250	Kurosaki	1937	G 115.0	G 115.0	I.G.	30	Coke (37%)
Shin Nippon Chisso Hiryo K.K.	400	Minamata	1910	E 98.2	E 100.0	Casale	60	Sulphate of ammonia
Asahi Kasei Kogyo K.K.	700	Nobeoka	1923	E 49.0	E 52.0	,,	3	Rayon (57%) Dynamite (9%)
TOTAL	5,215.5			E 663.9 G 1,425.8	E 734.1 G 1,906.0			

E = electrolytic process. G = gas process. *Converted to methanol production during the last war. †Formerly the Japanese Navy's fuel arsenal

the largest percentage of output in the case of one company and the second largest in the case of four companies (among these four, one is mainly a producer of calcium cyanamide and another concentrates on superphosphate of lime). Thus, sulphate of ammonia is the main fertiliser produced in Japan.

Production methods

The production methods used are almost completely based on foreign patents. Showa Denko K.K. is the only company using Japanese patents, but even this company's ammonia synthesis process is a modified form of the Haber-Bosch process. Another interesting aspect of the Japanese industry is the very wide use of the electrolytic process, in contrast with the rest of the world where it is used, on the average, for only 13% of output. Indeed, the Japanese sulphate of ammonia industry has developed through the use of cheap surplus electric power which became available in the depression years of the 1920s. Today, however, there is a power shortage and, in view of the disadvantages of seasonally reduced operating rates, production methods based on the dual use of electrolytic and gas processes are being developed to maintain a uniform rate of operation. Accordingly, the greater part of the production expansion schemes for the future are for the gas process.

Scale of production

At present, 14 companies owning 17 plants produce sulphate of ammonia as a major product; details are given on page 575. The economic scale for production in Japan is 100,000 tons p.a. and, as a number of these companies have not yet reached this level, practically all of them have plans to expand to this scale by July 1952. Only Asahi Kasei Kogyo K.K. and the Hikoshima plant of Toyo Koatsu Kogyo K.K. have no room for further expansion. In the case of Asahi Kasei Kogyo K.K., sulphate of ammonia accounts for only 3% of its total output, its main products being rayon and dynamite. In the case of the Hikoshima plant of Toyo Koatsu Kogyo K.K., this is the oldest of the company's three plants and, moreover, there is no space for further expansion, because Hikoshima is a small island forming a part of Shimonoseki city. If operations are maintained at 80% of capacity, which is the normal rate for the sulphate of ammonia industry, the estimated total production in 1952 will roughly meet the estimated demand of 2,000,000 tons.

Technology and productivity

In the gas process, the quantities of coal and coke required for the production of a metric ton of sulphate of ammonia have decreased from the average for 1938-40 of 1,300 kg. coal and 470 kg. coke to 1,250 kg. and 420 kg. respectively. In the electrolytic process, however, the quantity of electric power required in 1950 was 4,796 kWh/metric ton, compared with the 1938-40 amount of 4,100 kWh/metric ton. This is due to a lower operating rate, in turn due to a smaller allocation of electric power in comparison with the increased production capacity. In 1948 the figures were 1,450 kg. coal, 760 kg. coke and 5,180 kWh respectively.

The productivity per worker is only about two-thirds of the pre-war rate. Apparently this is because some enterprises have kept more workers than were actually needed, because profits were assured under the Government subsidy scheme in force during the post-war period. This scheme also encouraged expansion of production and maintained the price of the product at a steady level. However, the costs of coal and coke in Japan have risen by about 10% and 40% respectively since November 1950 and, moreover, electric power costs are also expected to be raised. On the other hand, the purchasing power of the Japanese farmers is low and therefore no immediate increase in the price of fertilisers is expected. Under these circumstances, the producers are now doing their utmost to increase productivity and reduce the cost of production as much as possible.

Technical shortcomings

According to an official statement, the Japanese sulphate of ammonia industry reached the world technical level before the war, but has since fallen behind that of Germany and the U.S.A. in several respects. For example, whereas the service life of catalyst used in the ammonia synthesis process is 15 years in the U.S.A., it is only three years at the longest and three months at the shortest in Japan. Further, Japanese gas-refining technology is also much inferior. In the U.S.A. the synthetic gas is refined to an extent that the impurity is reduced to 0.000005 mg./cu.m., compared with 0.00003 to 0.0001 mg. in Japan. Some even contain impurity as high as 0.0002 mg. This is the chief reason for the short life of the catalyst. Also, apart from the sulphate of ammonia industry, no chemical industry using ammonia as raw material has yet been developed in Japan. Moreover, practically no use is made of the oxygen gas generated during the separation of nitrogen and during the manufacture of hydrogen by the electrolysis of water, or of the carbonic-acid gas obtained from the manufacture of hydrogen by the gas process.

While the world demand for fertilisers remains at its present high level, increased output will be the main object of the Japanese sulphate of ammonia industry. The problem is how to finance the necessary industrial expansion and the electric power developments. One proposal put forward is to use the U.S. Aid Counterpart Fund for the former and to obtain other foreign capital for the latter.

Adhesives for Metals

TWO adhesives, one for glass-to-metal bonds and the other for metal-to-metal bonds are described by J. J. Jaklitsch, *Mechanical Engineering*, June 1951.

Glass to metal

The process of soldering glass to metal which, it is reported, makes a bond stronger than the glass itself has been developed by the General Electric Co., U.S.A. The method, which can also be used to solder metal to ceramics and carbon, is currently being tested for industrial applications by the company's laboratory. The glass and metal areas to be soldered are painted with a thin layer of titanium hydride, and solder is placed upon both painted areas. The parts are placed together and then heated under a vacuum. When the temperature reaches about 900°F. the titanium hydride decomposes. This causes the solder, which has already become molten, to adhere to the titanium-painted areas of both glass and metal. A strong tight bond is formed upon cooling. By using soft metal solders, it is possible to subject this glass-to-metal seal to rapid temperature changes without danger of cracking, despite the wide difference in temperature expansions between glass and metal. This is possible because the differences in movement are absorbed by the solder.

The new technique is now in use in aircraft ignition systems and laboratory investigations have suggested possible applications in the manufacture of transformers, capacitors and electric motors. These possibilities are now under consideration, according to laboratory engineers.

Rubber cement

A rubber cement called *Plastilock*, developed by the B. F. Goodrich Co., is said to be capable of sticking metal to metal with a bond stronger than rivets or nuts and bolts can make. The new rubber cement was first used to bond brake lining to brake shoes in motor vehicles. Latest models of U.S. fighting aircraft now have brake linings bonded with the new adhesive. Since *Plastilock* eliminates rivets in brake-lining applications, service life of the lining is automatically increased about 75%.

One manufacturer uses the adhesive to make a stronger and more serviceable petrol tank by cementing the metal sections together. Nuts, bolts and gaskets formerly used are no longer needed. Other advantages met in this case include speed of application, elimination of processes and the perfect seal *Plastilock* makes against petroleum products.

SIZE REDUCTION

Comminution theories, recent research, design improvements, special techniques

By R. V. Riley, Ph.D., B.Sc., F.I.M.

SIZE reduction is now well established as a unit operation. In a recent book on unit operations[1] a whole chapter is devoted to it. 'The purpose of size reduction,' states the author, 'is not only to make . . . "little ones out of big ones" . . . when the effectiveness can be measured by the degree of fineness of the product, but also to produce a product of the desired size or size range. The size requirements for various products may vary widely and hence different machines and procedures are employed.' Several well-known machines are described in the book, including jaw crushers, gyratory crushers, the Bradford breaker, the hammer mill, disintegrators, cone crushers, rolls, stamps, ball mills, rod mills, etc. The author outlines the accepted theory of roll crushers and gives energy requirements of ball mills with illustrative examples.

New theories of comminution

This reviewer entirely agrees with F. C. Bond and J.-T. Wang[2], who introduce their important paper on comminution as follows :

'The present status of the theory of comminution is extremely unsatisfactory. The amount of various ores and rock products crushed and ground annually approaches the staggering sum of half a billion tons, yet the basic concepts underlying an operation of such magnitude are unknown and actual knowledge of what takes place in comminution is almost entirely empirical. The responsibility for this situation cannot be charged to apathy or lack of appreciation of the importance of the problem. Many attempts have been made to evaluate a workable hypothesis but none has been completely successful.'

From research on the crushing and grinding of many materials in different machines J. Wang derives an empirical energy equation which is of considerable practical importance :

$$E = K\sqrt{n^4/P}$$

where E = the horse power hour per short ton.

K = 0.25 for soft materials.
0.50 for medium materials.
1.00 for hard materials.

n = reduction ratio at product size $= \frac{F}{P}$

P = product size, size in inches 80% of feed passes.

F = feed size, size in inches 80% of feed passes.

The authors then consider various theories in the light of the practical performance of crushers as forecast by a chart based upon this empirical equation. A new strain-energy theory is presented which is shown to fit in with practice more completely than any one of the classical theories alone, particularly for primary crushing. The strain-energy theory was developed to provide a working formula which would apply over the entire crushing and grinding range and would have a rigorous mathematical background based upon mechanics. Although the 'Kick' theory has such a background, it obviously assumes too large a proportion of the total energy input to reduction of the largest particles. The Rittinger theory is not tenable from the viewpoint of mechanics and has been criticised as assuming too much energy to reduction of the very fine particles, while requiring the use of a more or less arbitrary grind limit. Between the two extremes, the strain-energy theory appears to form a rationalisation which might lead ultimately to a more satisfactory concept of the theory of crushing and grinding.

The energy used in size reduction is large when viewed both from a national standpoint and upon a world basis. For example, it has been stated that the annual world production of cement during 1928 was 90,000,000 tons. For this some 250,000,000 tons of clinker and coal were milled, consuming 10,000,000,000 kWh, an amount of energy seven times the power consumption of greater Berlin in 1929.

Practically all of the energy required to fracture particles during crushing and grinding is energy of resilience. This energy deforms the material beyond its elastic limit and appears as heat released upon fracture. The amount absorbed as increased surface energy is probably very minute. Some account, however, must be taken of this change of surface energy and the experimental work of Engelhardt[3] demonstrates the magnitude of this. It is shown by electrical measurements that the grinding work done under given test conditions is only one-thousandth part of the gross energy which must be supplied to carry out the grinding operation.

[*Photo: S. N. Bridges & Co. Ltd.*

Triple dispersion homogenisers providing three separate grindings simultaneously, giving a fine blending of the ingredients. These machines are used for the manufacture of leather finishes, paper pigment coatings, etc., and for preparing foods such as ice cream, dairy products, mayonnaise, etc. For the latter purpose, special stainless steel working parts are available.

Particle size distribution of crushing

For some years there has been a growing appreciation of the importance of the particle size analysis and the particle shape of crushed products. These two factors, which can be influenced considerably by the choice of crusher and the operating conditions, are important because they affect (1) the percentage of useful material obtained from a crushed product, which has a direct bearing upon working costs ; (2) the physical properties of a crushed material, such as packing density, the flow of fluids through the mass, particle strength, surface area, and chemical reactivity.

A paper by A. Ratcliffe[4] on the distribution analysis of the particle sizes of typical crushed products is of value not only in itself but because of the interest aroused among contemporaries. Especially important are the contributions made to its discussion. In the work described, an examination is made of two particle size analyses which are typical of two categories of crushed products. One sample represents material reduced in a hammer mill ; subjected to indiscriminating reduction, it contains a preponderance of smaller sizes, and this is characteristic also of some ball mill products and the small particles in the products of jaw, gyratory and roll crushers. The second example illustrates the influence of the sizing action which occurs in the latter machines and results in a closer grading of the coarse particle fraction. These characteristic features are

PERFORMANCE OF COAL-CRUSHING PLANT

Type of mill	Commenced operations	Capacity		Fineness of grinding retained on sieve DIN 70	Method of sifting	Power required kWh/ton	Useful power efficiency %
		Rated tons/hr.	Actual tons/hr.				
Raymond pendulum mill	1926	6	5	12%	Air sifted	15	20—40
Fuller ball ring mill	1928	4	3	8%	Sieved	20	24
Rohr mill	1927	8	6.5—7.0	12—15%	Air sifted	25	70
Ball mill	1939	2	—	—	Air sifted	17	20—30
Ball mill	1928	3	1	8—10%	Air sifted	40	
Fuller ball ring mill		2.5	1.0	12%	Sieved	30	21
		4.0	1.9	37%	Sieved	22	
		2.5	2.8	50%	Sieved	19	
Roller mill	1926	1	0.65	35%	Not sifted	13	60—75
Ball mill	1934	3	2.2	14—32%	Air sifted	37	37
Coal dust roller mill	1940	4	4	14—22%	Air sifted	20	50
Coal dust pendulum mill	1940	6	5	18%	Air sifted	25	

illustrated by curves and a mathematical basis is given for Gaudin's law of particle size analysis.

In the grinding of pigments and inks, the particle size distribution may be determined by a Grindometer or draw-down fineness-of-grind gauge. Walker and Zettlemoyer have critically examined this method of determining the particle size distribution and report that little improvement in accuracy is likely to be obtained by the further development of this type of instrument.[5]

Performance of ball mills

Methods for the superfine grinding of coke and coal have been reviewed by R. A. Mott[6] in the light of recent experience at the Midland Coke Research Station. The wet and dry processes for the operation of a ball mill were compared and it was shown that wet milling, allowing grinding to take place without caking, was a method which resulted in a finer ultimate particle size. The limit with wet grinding of coke was reached at a fineness of 50 to 60 millimicrons, when the viscosity of the suspension became so great that further milling was ineffective. An interesting relationship between time of grinding and the surface area of the particles was found which was expressed graphically on log-log paper. An 0.6 to 2% addition of ammonium hydroxide gave a better dispersion in wet milling and prevented corrosion of the balls and mill liner. Wet ball milling also received the attention of E. J. Roberts,[7] who demonstrated the application of a probability theory. The theoretical treatment led to the conclusion that the amount of material ground through a given mesh per day was proportional to the percentage of material remaining on that mesh in contact with the balls and the net power applied to the balls at the point of contact. The value of a formula for ball wear in a mill grinding apatite ore was discussed by V. Yu Brand.[8] It was shown that the results fell out of line with theory when splitting of the balls occurred.

H. Hardinge and R. C. Ferguson[9] have published results of laboratory and plant trials which demonstrate the advantages in grinding efficiency obtained by a speed of operation slower than normal with certain mills. The increase in efficiency was such as to outweigh the higher capital cost of the larger units necessary to achieve the required output. A similar conclusion was arrived at by J. F. Myers and F. M. Lewis[10] from a study on ball consumption in a slow-speed mill in closed circuit with a hydroscillator. The increased grinding efficiency over conventional units was 28%. The relative wear rates of various diameter grinding balls in production mills is the subject of a paper by D. E. Norquist and J. E. Moeller.[11] Another interesting paper is that by J. J. Strohl and H. J. Schwellenbach,[12] which relates the effects of rod mill feed size to the efficiencies of operation and throughput. Bond[13] deals with the subject of selection of rod size for rod mills.

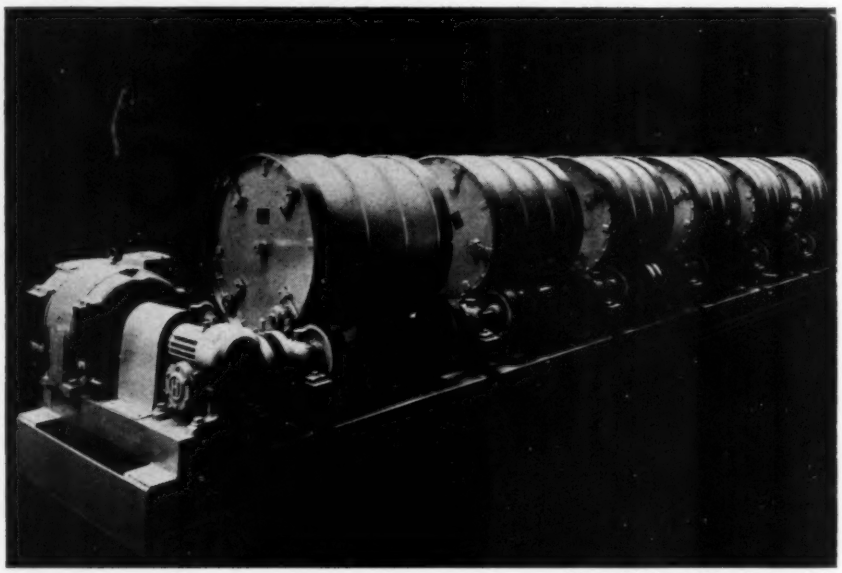
Crusher facts and figures

A recent booklet,[14] giving information on crushing, screening, washing, and material handling, is of interest to all users of comminution plant. Charts are presented showing the percentage of each size of stone to be expected in the produce of crushers. Useful data on mills grinding pulverised coal for iron and steel works in Germany are presented in an article by K. Kessels[15] (see the accompanying table from this paper).

In a series of articles on crushing practice and theory, B. McGrew[16] describes rock-crushing methods in some detail. J. W. Axelson and E. L. Piret[17] have described the crushing of single particles of crystalline quartz. It was found that the average efficiency for the crushing of a single crystal was 9.4% and the average efficiency when crushing multiple particles of the same quartz was only 1.4%. A hypothesis was proposed to account for the lower efficiency of multiple particle crushing.

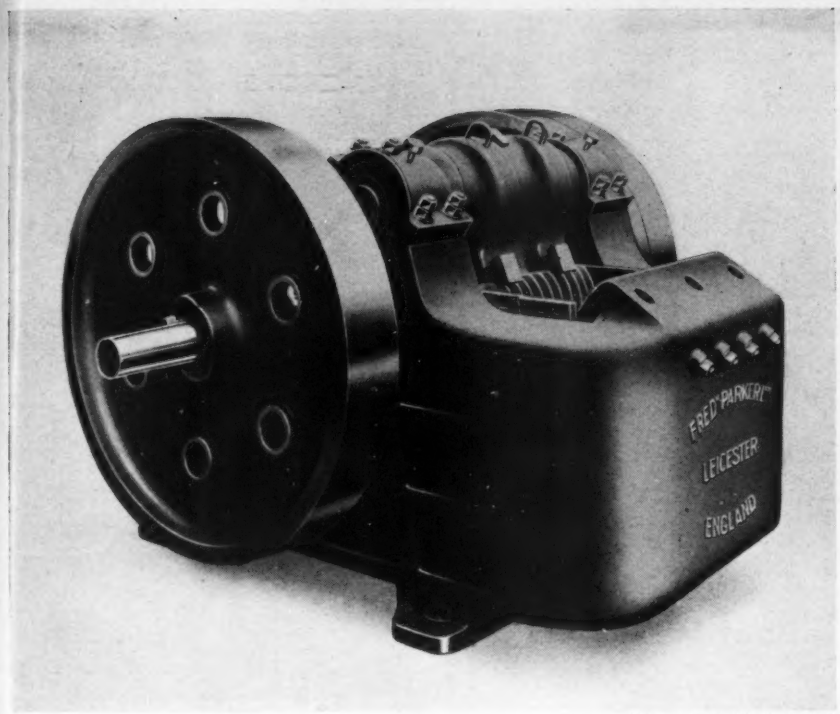
Recent research

Some materials which are tough or fibrous at normal temperatures become hard or brittle when cooled. These materials can be troublesome to disintegrate in their normal form, but when subjected to intense cooling may be readily broken up in standard type crushers and grinders. Liquid nitrogen has been used



[Photo: Wilkinson Rubber Linatex Ltd.

The six-in-line C.20 'Linatex' ball mill unit. These mills are all lined with 'Linatex' rubber type liners.



[*Photo: Frederick Parker Ltd.*

Monarch Super Blake double-toggle crusher for the primary crushing of rock and ores. It is claimed that the 'Hydrol' bearings make possible a 25 to 30% increase in output over the old Blake type crusher with only a slight increase in the brake horse power consumed.

as a coolant for this purpose by an American firm.[18] The process results in grinding to more regular shaped particles. Furthermore, it may be used for heat-sensitive chemicals, for example substances containing vitamins and products which might otherwise lose an aromatic component.

The disintegration of rocks by ultrasonic vibrations is a development which may become of more than academic interest in the future.[19] Pulverisation of mineral-bearing rocks has been described by Russian authors,[20] who were concerned largely with the establishment of a theory connecting degree of crushing with the exposure of mineral and the final composition of mixed grain.

The jaws of rock crushers are usually toothed ; the effect of the teeth and their subsequent wear upon the shape and grading of the product has been investigated by A. Joisel.[21] The results lead to the assertion that teeth are unnecessary on gyratory crushers. Toothed jaws do not apparently improve either the size or shape of the product, but require more power than plain jaws, while the output of the crusher is only slightly improved.

Radioactive isotope techniques have not escaped the attention of technologists engaged in size reduction. V. L. Mattson[22] describes an application of tracer isotopes in a flotation process following crushing. The winning of uranium ore is described by F. W. McQuiston.[23] The crushing and grinding methods follow standard mill practice. The processing of uranium ores is quite similar to the methods used for the treatment of gold and silver ores.

The hardness of diamond, always regarded as the hardest known material, has been measured with some precision by M. N. Khrushchov and E. S. Berkovich.[24] The pyramid hardnesses of this and other hard materials are given as :

Material	*Hardness kg./sq.mm.*
Diamond	10,000
Boron carbide	3,700
Tungsten carbide ..	3,200—3,400
Synthetic corundum ..	2,000—2,200
Hard chromium diffused on steel	1,600

Dust explosions

There is continued interest in research into dust explosions and fires. H. R. Brown[25] states that the United States Fire Protection Association, Dust Explosion Hazards Committee, has prepared 17 codes or standards required for different industries. Almost any fine dust can form a potential explosive mixture under certain conditions, but aluminium powder is well known as a special danger. Details of an explosion that occurred at a large aluminium factory in 1950 have been given.[26] It occurred while aluminium paste was being milled with carbon tetrachloride. Experiments have shown that aluminium powder may also react violently with trichlorethylene solvent when hot. Potential dust explosions can be prevented or minimised by the elimination of static electricity. One modern method of discharging high voltages continuously and safely is by the use of radioactivity.[27] However, the commercial value of electrostatic separation applied to 'safe' particle mixtures must not be overlooked.[28]

Improvements in mill and crusher design

Many of these are small modifications, often of great importance to the plant operator. Others are of special significance in starting new trends. Noteworthy improvements in gyratory crushers have been described in patent specifications.[29, 30] A new ball mill patented by L. G. Symons[31] is made to gyrate about a conical axis.

A new vibratory ball mill was constructed at the U.S. National Bureau of Standards[32] for the laboratory grinding of cotton fibre into particles a few microns in length. Vibratory motion was imparted to the grinding jar by a ¼-h.p. motor which rotated an eccentric weight in a housing supported by leaf springs. A synthetic sapphire known as *Borundum*[33] has been developed for a ball mill medium and is claimed to be much more resistant than a flint pebble or porcelain ball. Synthetic sapphire has also been used for the manufacture of a laboratory pestle and mortar.[34] It is said to be as hard as tungsten carbide and is resistant to the corrosive action of a number of laboratory chemicals. The more conventional iron grinding balls may now be cast continuously by a process described by P. M. Payne and F. G. Steinebach.[35]

Lubrication of crushing plant, always difficult, is discussed in a paper by F. Lebeter.[36] A patent by M. E. Meinhardt[37] also describes an improvement in the technique of lubrication. Excessive temperature rise in ball mills due to ball and stock friction can be harmful to the product and a source of danger at trunnion bearings. Overheating may be prevented with a water-jacketed shell, the subject of a new British patent.[38]

Attention has been given to the employment of lighter methods of construction for the moving parts of crushers. Welding instead of casting is one way of reducing inertia.[39] On the other hand, a cast magnesium alloy rotor has been proposed for a flour mill. This rotor rim travels at approximately 25,000 ft./min. and 20 steel crusher bars inserted into the periphery exert a radial load of about 3,800 lb. each. Despite this, the maximum stress at any point is limited by the ribbed design to 2,000 lb./sq.in. and the cast rotor has given a satisfactory performance.[40]

Rubber offers unique properties as a wear-resistant tough lining material for ball mills used for milling corrosive chemicals. In a recent mill, the construction is such that the lining is permanently under compression, which is the ideal state for resisting abrasion.[41] Rubber sheeting is also used as a resilient underliner for mills

fitted with abrasion-resisting iron liner plates. This rubber liner, besides helping to avoid breakages of the abrasion-resistant iron liner plates, also prevents the abrasion and consequent weakening of the steel shell by grindings penetrating along the joints of the internal liner. M. P. Doyen[43] discusses the application of a martensitic alloy white iron of *Ni-hard* composition for the construction of mill liner plates. The superiority of this material is already well known, but this paper contains new data of interest to workers in cement, ore, coke, refractories and paint industries. The use of a similar alloy cast iron for the manufacture of paint grinding balls is commented upon by K. A. de Longe.[43]

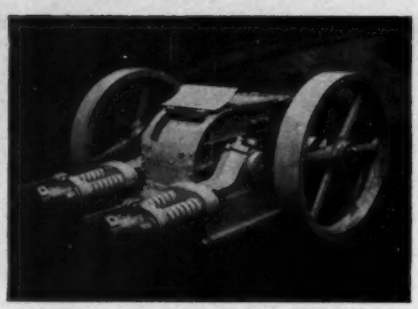
An acoustic device suitable for the control of the feed in the continuous milling of chemicals and minerals has been described.[44, 45] The noise level of the cascading grist and balls in contact with each other and with the liner of the mill determines the rate of feed of raw material to the mill. A device of this kind prevents the overloading of the mill, with the consequent loss of efficiency, or alternatively its running light, which state is often the cause of excessive liner wear or breakage.

A new *Mikro-Atomizer* combines a hammer mill disintegrator with a type of classifier.[46] After the initial stage of reduction by rotating hammers, the material being reduced is carried by an air stream into a separator wheel where, under the influence of centrifugal force in opposition to a strong suction, the fine particles are removed, while the coarser materials return to the disintegrator. Improvements in colloid mills are described in British patent specification No. 643,249[47] and by L. Rosenfeld.[48]

Special techniques

As would be expected, the crushing of 'boart' or low-grade diamonds for industrial applications is an extremely arduous operation. According to a recent article by R. S. Young,[49] boart is crushed in two stages; firstly, by a small jaw crusher and, secondly, by a roll crusher. The jaw crushing is the major operation, hence the jaw crusher plates must withstand the impact and abrasion of the hardest known substance. Martensitic white iron was found to give the best service. Its magnetic properties were useful in enabling a separation of the metallics from the product. It was possible to crush 1,000,000 carats or 440 lb. of industrial diamonds before failure of the martensitic iron jaws.

The milling of asbestos[50] consists of separating the fibre from the barren rock by repetitive crushing, screening and air separation. A typical mill flow-sheet includes primary and secondary rock crushing to 3-in. size, furnace drying to remove moisture and third-stage crushing to free the fibre. The third-stage crushed product is then screened and the fines are disintegrated to fluff the fibres. For the fine grinding of talc (a mineral from the same mineralogical species as asbestos) the fluid energy reduction mill using steam has been applied[51] to give three grades of average particle size, 6.0, 1.5 and 0.8 micron.



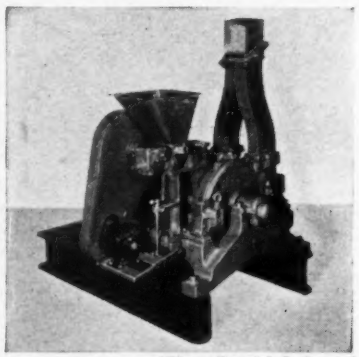
[Photo: Edgar Allen & Co. Ltd.

High-speed crushing rolls, 18 in. × 12 in., working at peripheral speeds from 700 to 1,000 ft./min., for the secondary crushing of ores.

Clay milling has been discussed by W. Avenhaus[52] and K. Spingler.[53] The first author gives an interesting method of calculating the specific output of an edge runner mill and the latter gives practical hints on the use of crushing rolls. An attrition grinder which dries clay at the same time as grinding was mentioned by H. W. Perrott.[54] M. M. Fine[55] describes the grinding and classification of graded sand for glass manufacture.

Continued research into the crushing of iron ores has been reported again in two papers by investigators of the British Iron and Steel Research Association.[56, 57] These articles treat the special problems associated with the crushing of sticky Northamptonshire iron stone. It was found that the 'build up' of fines on the stationary breaker plate of a swing hammer mill could stop the crushing when the hammer tips became worn. This build-up could be most satisfactorily avoided by a new design incorporating two hammers mounted side by side without a stationary breaker plate. The mill was somewhat similar to a high-speed double-roll crusher, but with the advantage that the hammers kept clean owing to the high speed of operation.

J. Lomas[58] describes the grinding of quicklime by a ring roll mill, ball mill and hammer mill to give uniform sized products $\frac{1}{8}$ to 2 in. depending upon requirements. There are conflicting views upon the need for very fine grinding of quicklime before hydration, but for the sugar-beet industry a fineness of 200 mesh is required, which is achieved in a ball mill with air separation. Two-stage crushing of calcium carbide in jaw mill and cone crusher, followed by blending with calcium cyanide and fluorspar in a ball mill to give a mixture of −100 mesh is the method used in the early stages for the manufacture of calcium cyanamide.[59] The mill, states M. L. Kastens and W. G. McBurney, is divided into chambers having progressively smaller diameter balls. The whole operation must be carried out in an atmosphere free from moisture.



[Photo: Bramigk & Co. Ltd.

'Mikro-Atomiser,' No. 6, a new mechanical screenless pulveriser for the efficient production of powders from 2 to 25 microns. The unit illustrated is equipped with a 20-h.p. motor.

Manufacturers of phosphate fertilisers will be interested in two papers,[60, 61] one British and one American, which describe current methods of crushing the rock and the final granulation of the product. E. C. Ellwood,[62] in making a comparison between gold ore treatment in South Africa and Canada, suggests the wider use of pebbles for grinding in the Canadian goldfields. In the discussion of this paper doubt was expressed as to whether the rod mill could compete with the pebble mill on costs. The real function of the rod mill was to take the place of a secondary fine crusher. The primary crushing of Scheelite tungsten ores in California is achieved by jaw crusher.[63]

E. E. Bryant[64] has described in some detail the ball milling of enamel frit to −200 mesh. Sulphur crushing by a 'meat mincer' type of crusher is carried out at the works of one important American sulphur producer.[65] An American public utility corporation has given interesting test data on coal pulverising.[66] Sewage disposal has been aided by a new disintegrator.[67]

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New Books

Cellulose Acetate Plastics

The cellulose acetate plastics industry has grown tremendously during the past 20 years or so. This plastic has found its way into nearly every industry by virtue of its toughness, transparency and the ease with which it can be manipulated and worked. Thus there should be wide interest in this comprehensive technical survey* of the subject which has been written with the intention of its being equally useful to the general reader, the business man and to the engineer and chemist. This attempt at being ' all things to all men ' has resulted in a comparatively superficial coverage in some instances. The author has sought to offset this by making his literature references as complete and pertinent as possible.

The chapters deal with the history and manufacture of cellulose acetate, the ingredients of cellulose acetate plastics, the manufacture of plastic film and sheet, the manufacture and use of moulding powder, the properties of cellulose acetate, fabrication and finishing, container manufacture and applications. The book contains nearly 200 illustrations and diagrams and more than 50 tables.

* *Cellulose Acetate Plastics*, by Dr. V. Stannett. Temple Press, London, 1950, pp. 325 incl. index, 30s. net.

Plasticisers

A guide to the great number of substances which have been developed on both sides of the Atlantic for use as plasticisers will be found in a recently published book* one of the few works devoted entirely to this subject. Emphasis is laid on those plasticisers which have already found commercial application or are likely to. Altogether 400 are considered and, although it is inevitable that some of immediate value may have been omitted, every effort has been made to make it comprehensive.

**Plasticisers*, by D. N. Buttrey. Cleaver-Hume Press Ltd., London, 1950, pp. 175 incl. index, 18s. net.

The 11 chapters deal, respectively, with phthalate esters, phosphoric acid derivatives, glycerol and glycol derivatives, adipic and sebacic acid esters, fatty acid esters, abietic and ricinoleic acid esters, toluene sulphonic acid derivatives, diphenyl derivatives, miscellaneous plasticisers, hydrocarbon and aromatic extenders, and the function of the plasticiser. There are also 63 tables, 19 diagrams, a bibliography and an index.

This is essentially a working handbook and, apart from one chapter on theoretical aspects, it is devoted to describing the various plasticisers, grouped according to chemical type. Space given to each varies from half to four pages, giving properties, all relevant physical data, actual and potential applications, and other points of interest not only to processing but to research departments. Much of the data has been obtained from the manufacturers of plasticisers.

Iron and Steel Analysis

Selected methods of analysis of iron, steel and ferro-alloys adopted by and actually in use as standard in the laboratories of the United Steel Co. Ltd., the largest producers of steel in the British Commonwealth, are described in this fourth edition* of a textbook which has become increasingly popular since it was first published in 1933. The methods described in the third edition (1945) have been revised. Several have been replaced by more satisfactory procedures, and methods have been included for boron and iron. The major addition is a new section dealing with physico-chemical techniques, such as absorptiometric and polarographic methods, which have proved of great value in service. The methods described in another section for the important constituents of fluorspar should be of interest to many steel works' chemists.

In compiling the book, note has been taken of the recommendation of the Commission on Inorganic Nomenclature of the International Union of Chemistry at the Amsterdam conference, September 1949, concerning names of certain elements. The more important of these in this case are the elements colombium and tungsten, for which the following names are recommended : niobium and wolfram. In this edition, niobium has been used to the exclusion of columbium, but tungsten has been retained, as wolfram is not in accordance with common usage in the English-speaking world.

The work has been used as a standard textbook for advanced students in all British technical colleges where metallurgy is taught and this new edition should be even more popular than its predecessors, as it has a wider sphere of usefulness.

**Standard Methods of Analysis of Iron, Steel and Ferro-Alloys as used by the Laboratories of the United Steel Companies Ltd.* Sheffield, 1951, pp. 169 incl. index, 17s. 6d.

WORLD CHEMICAL CONFERENCE

The many fields of pure and applied chemistry and chemical engineering were surveyed at the Diamond Jubilee Meeting of the American Chemical Society held in New York in September. Some 700 technical papers were presented at the 80 symposia and the meeting was attended by 18,000 chemists and chemical engineers from more than 40 countries. The A.C.S. Jubilee was followed by the 16th Conference of the International Union of Pure and Applied Chemistry and the 12th International Congress of Pure and Applied Chemistry. Below are summaries of some of the papers of chemical engineering interest which were presented at these meetings. The subjects covered include the disposal of industrial and radioactive effluents, the production of synthetic fuels and chemicals from natural gas, the recovery of sulphur from flue gases and of sulphuric acid from processing liquids, the production of wax from Irish peat, and the development of the fluorine chemicals.

Sulphur from flue gas

A PROCESS to extract sulphur from flue gas from burning coal was described by S. R. Craxford, A. Poll and W. J. S. Walker, Fuel Research Station, Department of Scientific and Industrial Research, London.

It removes more than 95% of the sulphur from the gas and recovers the sulphur in usable form.

Flue gas is washed with a solution of ammonia to recover the sulphur as ammonium sulphate and some free sulphur. An electrical method measures and records the vapour pressures of sulphur dioxide and ammonia in equilibrium with the scrubber liquor.

This method has been tested in a small pilot plant treating 1,000 cu.ft./hr. of flue gas. A plant has now been built that can treat 25,000 cu.ft./hr. of flue gas, to determine what probable commercial costs of operation would be. Earlier estimates placed the cost at 9s./ton of coal burned, after allowing credits for the sulphur recovered.

The amount of coal used in Great Britain is about 190,000,000 tons p.a. and its average sulphur content is 1.5%. A large proportion of this coal is burnt directly and, as a result, about 2,300,000 tons of sulphur is released into the atmosphere as sulphur dioxide and sulphur trioxide.

For every ton of coal burnt about 500,000 cu. ft. of flue gas are produced, so that the sulphur dioxide is only present at very low concentrations, normally not exceeding 0.1%. This constitutes the basic difficulty of the problem, as it necessitates large and complicated plant for the removal of the sulphur dioxide and renders the process extremely expensive even in the most favourable cases of the largest coal-burning units, such as electricity generating stations. Generating stations are usually the largest single emitters of sulphur compounds in thickly populated areas and for some time considerable attention has been given to the pollution of the atmosphere produced by them. As a result, when official sanction was granted for the erection of the last three power stations in London, clauses were inserted stipulating that the greater part of the sulphur compounds should be removed from the flue gas. Thus gas-washing plant was installed and operated at the base-load stations at Battersea and Fulham and a third plant is now being built at the new generating station at Bankside.

At Battersea the flue gas is washed with such large volumes of river water, to which a little chalk is added to provide extra alkali, that the calcium sulphate formed as the product remains in solution can be discharged into the river. It is estimated that the total cost of this process is about 7s./ton of coal burnt and, although it removes more than 90% of the sulphur compounds from the gas, none is recovered in a useful form. A similar plant is being installed at Bankside. This process requires so great a quantity of river water to keep the calcium sulphate in solution that the flow of the Thames will only be sufficient for the Battersea and Bankside plants, and if a gas-washing plant were to be installed at another generating station in London some other system would have to be used.

A non-effluent process was in fact used at the Fulham generating station before the war, the flue gas being scrubbed by a circulating suspension of lime or chalk in water. The calcium sulphate produced was separated as a moist solid which was valueless on account of contamination by dust and grit from the gas. It is estimated that if a new plant were built to work this process the total cost would be about 10s./ton of coal burnt.

This being the position, consideration was given to devising a process of scrubbing with a solution of ammonia instead of a suspension of lime or chalk to enable the sulphur to be recovered in a useful form, namely as ammonium sulphate. Such a process was proposed for Fulham, but it was found to be very difficult to maintain conditions under which neither ammonia nor sulphur dioxide was lost in the gas leaving the scrubber. Subsequently an electrical method was developed for measuring and recording the vapour pressures of sulphur dioxide and ammonia in equilibrium with the scrubber liquor, and the authors gave an account of work at the Fuel Research Station with a small pilot plant treating 1,000 cu.ft./hr. of flue gas to test this method. Conditions were discovered for which the composition of the liquor could be controlled so that neither sulphur dioxide nor ammonia passed off in the scrubbed gas. More than 95% of the sulphur dioxide could be removed from the flue gas in this way and, when the scrubber liquor was heated in an autoclave, good-quality ammonium sulphate together with a little free sulphur was produced.

Estimates prepared a year ago showed that, after allowing credits for the ammonium sulphate and sulphur produced, it would probably cost 9s./ton of coal burnt to wash flue gas by this process.

Sulphuric acid recovery

A new sulphuric acid recovery process for steel mills, oil refineries and titanium pigment plants, which may help conserve sulphur supplies, was reported by F. J. Bartholomew, Chemical Construction Corp. It is said to recover 85 to 90% of the acid normally discarded in the pickling operation of a steel mill, including the acid contained in the iron scale and rust.

The object of the recovery process is to return the sulphuric acid remaining in the used pickle liquor to the pickling operation for re-use, to recover the acid in the iron sulphate of the scale and to return the rust and scale to the blast furnaces as iron oxide. It involves separation of the iron sulphate by crystallisation, after concentrating the liquor by submerged combustion in a special burner. The sulphate is filtered out of the liquid on a plastic filter supported by a lead frame. This sulphate is mixed with coal and roasted to produce sulphur dioxide gas, which can easily be converted back into sulphuric acid, and iron oxide which can be returned to the blast furnace. Because of the high investment required and the cost of fuel for water evaporation it is, however, difficult to show a favourable return on a steel mill pickle liquor recovery plant.

The recovery situation is somewhat different as it applies to titanium pigment manufacturers. The by-product from this industry is in such form that recovery is economically feasible. Some objections have been raised by pigment manufac-

turers, stating that the acid recovered by concentration carries impurities that would contaminate the pigment if the acid were re-used. However, there would be a ready market for the recovered acid in other industries and roasted sulphate would produce an acid of a purity suitable for any purpose.

The process described cannot be utilised economically in all cases, but it is a practical one and can be applied when a scarcity of raw materials or other attending circumstances make it advisable.

Wax from Irish peat

Ireland's tremendous peat deposits represent an important natural resource aside from their value as fuel. Prof. Joseph Reilly and Dr. Liam Mulcahy, University College, Cork, said one of the most valuable of all the potential by-products of peat is a wax which has a relatively high melting point and is promising from a technical aspect. The wax, known as Mona wax, contains approximately 50% of a complex bitumen material, 35% of peat esters and 15% of resin. Processing produces waxes varying in colour from dark brown to white and also produces some changes in physical properties.

From tests so far made there are indications that the wax has economic possibilities and if produced on the industrial scale may be a useful addition to the available natural waxes.

Approximately one-fifth of the land surface of Ireland is made up of peat-land and these millions of tons of peat are of great chemical interest because the peat comprises a large mass of complex chemical organic substances which may provide cellulose products, humic acid, fermentable carbohydrates, waxes, peat tar and tar oils as well as combustible gases. All these materials, however, are of very low grade, and this presents difficulties in developing them industrially. The wax is a possible exception to this rule. Depending on the type of solvent treatment of the peat, extraction yields of up to 16% Mona wax can be obtained from the peat. The extraction with petroleum ether from a suitable peat gave a yield of approximately 7% on the dry material and this type of wax product was found to be promising from the technical aspect. In a semi-technical plant approximately 1,500 lb. of this type of wax was obtained.

Industrial uses of fluorine

New chemicals with many unusual uses are being obtained from fluorine gas, stated Dr. James O. Hendricks, Minnesota Mining & Manufacturing Co. This new family comprises the fluorochemicals. Uses, present or foreseen, include flame extinguishers, lubricants that withstand great heat, coolants for electrical equipment, aids in electroplating, new resins, and as tools to separate and purify rare metals in atomic energy studies.

The industrial potential of fluorochemicals has been slow in developing, due to the lack of a simple, economical means of production. Previously, only the simpler molecules or polymers of simpler molecules have been available commercially. Examples of such compounds are *Freons*, *Teflon*, *Genetrons* and *Kel-F*. The discovery of the electrochemical fluorination process by Dr. J. H. Simons, of Pennsylvania State College, has greatly increased the number and types of fluorinated organic compounds which can be produced on a practical scale. The commercialisation of this process by the Minnesota Mining & Manufacturing Co. is well under way.

A series of perfluoro organic acids, starting with perfluoro-acetic acid, have been made in the electrochemical cell. A number of applications of the perfluoro acids are developing. The Atomic Energy Commission has published papers on the separation and purification of certain rare metals by means of thenoyl trifluoroacetone (TTA). Hafnium can be separated from zirconium rather efficiently. In the preparation of the radioisotope carbon-45 the impurity scandium is removed by using TTA. These processes are of interest to the A.E.C. Trifluoroacetic acid can be used as one of the starting materials for the preparation of TTA.

The higher perfluoroacids, for example perfluorocaprylic, and their salts lower the surface tension of water solutions to a very unusual degree. No known soaps or surface-active agents will reduce surface tension of water as much. One industry which may use these stable surface-tension-lowering materials is electroplating. It is envisioned that foams for numerous purposes could be logical uses. Recently issued patents indicate that the salts of the higher perfluoro acids act as dispersing agents in the polymerisation of *Teflon*.

Highly fluorinated materials are characterised by high specific gravity, low refractive index and non-flammability. An example of a high-boiling liquid of this type is the pentaerythritol ester of perfluorobutyric acid. In many ways it resembles the liquid fluorocarbons, but its viscosity changes less with changing temperature. Examples of other highly fluorinated liquids are triperfluorobutyl amine and diperfluorohexyl ether. The basic character of each compound has entirely disappeared and they resemble the perfluorocarbons in this respect. The compounds are remarkably stable and can be heated to 500°C. in the absence or presence of air. The dielectric constant of each is very low, less than 2. These liquids have interesting possibilities in precision instruments where their non-corrosiveness, high density and heat stability are important. Their low dielectric constant may make them suitable for use as liquid coolants in electrical equipment where very high-frequency pulses are encountered.

Liquid polymers of trifluorochloroethylene (*Kel-F* monomer) are finding specialised uses as lubricants because of their high-temperature stability and lubricity. The newer perfluoro liquids mentioned above may also find application for this purpose. They remain liquid over a wider temperature range.

Vinyl perfluoroesters have been prepared by reacting acetylene with a number of the perfluoro acids, starting with the C_2 acid and going as high as C_{10}. The monomers polymerise to yield transparent, colourless, thermoplastic resins.

Polyvinyl perfluoroacetate has been made before, but the higher vinylesters and polymers are new. These polymers are still in the experimental stage. They are soluble in a number of fluorinated solvents.

A number of derivatives have been made from the perfluoro acids. Some required new syntheses and others were prepared according to methods already worked out in the hydrogen series. Especial attention is called to the perfluoro aldehydes, an entirely new class of perfluoro compounds. They form polymers which have shown resistance to hot, concentrated nitric acid. These are still in the laboratory stage of development.

A special derivative of trifluoroacetic acid is trifluoromethyl bromide (CF_3Br). It has exceptional efficiency as a flame extinguisher. It has the advantage of relatively non-toxic by-products after a fire has been put out in comparison with other flame extinguishers.

Reducing oil refinery waste

Waste water from a petroleum refinery has been reduced by 95%, and equipment is under construction to cut it further to only 3% of its former volume, through a pollution abatement programme, reported by N. J. Gothard and J. A. Fowler of the Sinclair Refining Co.

The amount of oil in this refinery effluent has been reduced by half, in spite of the fact that the refinery's capacity has been doubled in the meantime. Other chemical contaminants can be removed at the refinery drains, and much has been accomplished by ' good housekeeping ' and the proper instruction of refinery operators.

The most important feature of the programme was the reduction of the volume of the overall refinery effluent. This was accomplished by installing cooling towers for recycling all cooling and condensing water and by reducing the volume of process water wherever possible. Without these reduction-of-volume measures the volume of the effluent from the present 90,000 to 95,000 barrels/day refinery would be more than 100,000 gal./min. ; with these measures, the volume is approximately 5,000 gal./min., and construction is in progress which will further reduce the volume of the effluent to approximately 3,000 gal./min.

To remove oil from this reduced refinery effluent an oil-water separator designed according to the latest edition of

the American Petroleum Institute's *Manual on Disposal of Refinery Wastes* was installed. With this A.P.I. separator, operating on the present 5,000 gal./min. effluent, the amount of oil contained in the refinery effluent has been reduced to approximately one-half the amount that the effluent formerly contained, even though the crude capacity of the refinery has been increased from 55,000 barrels/day to 90,000 to 95,000 barrels/day. A further reduction in the oil content of the refinery effluent undoubtedly will occur when the effluent is further reduced in volume from 5,000 to 3,000 gal./min.

Water-soluble pollutants such as sulphides and phenol can be removed best at their source before they enter the refinery sewers. Much has been accomplished along this line at the refinery through good housekeeping measures, *i.e.* by impressing on the operators of the various units the importance of eliminating pollution at its source. In some cases, however, it has been necessary to construct new units for the purpose of eliminating pollution at its source. Through the construction and operation of such units at East Chicago, sulphides have been eliminated as a pollution problem and pollution by phenols has been reduced by approximately 90%.

The reduction-of-volume approach to the pollution-abatement problem has resulted in the concentration of pollutants in a comparatively small volume of water ; therefore the tests in parts per million do not indicate a great reduction in pollution ; however, when pollution on lb./day basis is considered, it is evident that the pollution abatement programme at the East Chicago refinery has resulted in a great reduction in the amount of pollution entering Lake Michigan from that refinery.

Disposal of radioactive wastes

The U.S. Atomic Energy Commission recently announced that at least three ways of removing dangerous, intense radioactivity from atomic process wastes had been evolved. J. H. Hayner, of the A.E.C., described how evaporation, ion exchange and coprecipitation were effective in taking out the radioactivity. These three processes, if combined with burying the concentrated active radioactive principles removed, are the most likely approach to resolution of the waste problem. Working with liquid waste in which there is dissolved material equivalent in radioactivity to at least 1 g. of radium/gal., it has been possible to reduce the dangerous emanations by 10,000,000.

Evaporating the water from liquid waste, together with the use of glass wool filters, effectively extracts the radioactivity and produces a distillate that can be safely discharged into a river. By running the contaminated liquid over beds of ion exchange resins it is possible to immediately reduce the volume of these high-level wastes at least by 50% and produce an effluent that can be safely discharged.

The third method, coprecipitation, involves the introduction of a chemical reaction in the waste liquid that will precipitate the radioactive chemical, which falls to the bottom of a tank from which it can be collected.

The Atomic Energy Commission is also considering special methods of ' compression evaporation ' and distillation, using the sun's heat. Work is also being carried out on crystallisation and distillation methods that will separate inactive useful chemicals from the radioactive fission products and then isolate the various radioactive isotopes.

Economic factors dictate that serious effort should be made to recover these materials and recently a cross-section of the industry was surveyed regarding the possible industrial application of these fission products.

In discussing the difficulty of the waste problem the author noted that of 1,000,000 gal. of dangerous liquids only a few per cent. of inactive process chemicals and almost minute amounts of the radioactive fission products create the hazard. The masses involved in tremendous quantities of radioactivity are frequently so small that ordinarily one would consider the material chemically pure and apply the principles of trace chemistry.

Two new isotopes

The two heaviest atoms ever known have been made at the radiation laboratory of the University of California at Berkeley, in the form of isotopes of berkelium and californium, elements 97 and 98, respectively. The new isotopes are berkelium-245 and californium-246, according to E. K. Hulet, S. G. Thompson, A. Ghiorso and K. Street. The authors produced these new isotopes by atomic bombardments in a 60-in. cyclotron and they provide two of the missing links in the pattern of radioactivity of the transuranium elements.

The new berkelium isotope has a half-life of about five days. It was produced by bombarding samples of curium 242, curium 243 and curium 244 with 35,000,000 electron volt helium ions and 18,000,000 electron volt deuterons. Curium is element 96 in the periodic table. Berkelium-245 decays predominantly by electron capture. Alpha particles of various energies were observed in the decay. The fraction of the decay giving alpha particles is 0.1%.

If it is assumed that this isotope is BK245, the failure to observe its daughter curium 245 indicates that the latter has an alpha decay half-life of greater than 500 years. The bombardment also produced relatively large amounts of the 35-hr. isotope californium 246, and the mass assignment was proved by observation of the growth of the daughter curium 242. Californium and berkelium are the last two elements to be discovered, although some nuclear scientists believe five more might some day be discovered or detected.

Petrol and chemicals from natural gas

Thousands of barrels of petrol and a number of other essential chemicals could be created every year from natural gas without jeopardising present and future needs for utility and other fuel purposes, according to P. C. Keith and J. H. Arnold, Hydrocarbon Research Inc., New York. The chemicals would include millions of gallons of ethyl alcohol, acetylene and the rare gases krypton and xenon. The synthetic fuels industry could be based on the Fischer-Tropsch type of synthesis, to make high-octane petrol from natural gas.

Of particular interest is the discovery that the environment of the catalyst, *i.e.* the composition of the gas flowing through the catalyst chamber, is equally as important as the catalyst preparation, both in achieving the desired product and in preserving the activity and selectivity of the catalyst. The catalyst used in the process is iron in a fluidised bed.

On the basis of proven and projected natural gas reserves of the United States, 2,000,000,000,000 cu. ft. could be made available annually for conversion to synthetic fuels, special chemicals, etc., without jeopardising present and future needs for utility and other fuel purposes. A synthetic fuels industry based upon one-fourth the estimated available gas, or an annual consumption of 500,000,000,000 cu. ft., could supply 90,000 barrels of petrol or 5% of the present demand.

In addition such a synthetic fuels industry would produce ethyl alcohol almost equal to the entire U.S. production in 1948, *i.e.* 130,000,000 gal. Millions of gallons of higher alcohols, aldehydes, ketones and fatty acids not now available, or available in limited amounts, would also be produced annually.

Other chemicals and special products for which there is a growing demand would be available in large quantities as by-products of the synthesis process or could be made available by simple, commercially proven operations. Probably most important among these are the straight-chain olefines and acetylene. Ethylene, propylene and higher molecular weight olefines would be available as by-products and acetylene could be readily produced by a modification of the combustion process. The quantities of these chemicals potentially available would give a tremendous impetus to the already rapidly expanding synthetic chemicals industry, plastics, synthetic fibres, solvents and so forth.

Tremendous quantities of oxygen would be separated from air and this operation would make feasible the recovery of krypton and xenon in amounts sufficient for the manufacture for general use of highly efficient incandescent lamps of the type now used in special miners' lamps and high-powered searchlights.

Collateral engineering and manufacturing benefits of the development of the synthetic fuels from natural gas industry would be the widespread application of techniques useful in many other industries. For example, the production of tonnage oxygen useful in the steel and chemical industries ; the efficient production of mixtures of carbon monoxide and hydrogen for synthesis of ammonia, methanol and other chemicals ; many new applications of unit operations of chemical engineering, for example the simultaneous removal of large quantities of heat and the control of temperature of reacting vapours, the handling of gases and liquids under pressure at temperatures as low as –300°F. and the handling of gases under pressure at temperatures up to 2,600 to 2,800°F.

Higher anti-knock petrol

Two of the most important practical problems in the chemical world today are improvement of the anti-knock rating of petrols and increasing the amount of aromatics available as raw materials for synthetic plastics and rubber. A process to help solve these problems was described by E. C. Hughes, H. M. Stine and H. A. Strecker, the Standard Oil Co., and S. C. Eastwood, C. L. Gutzeit, W. A. Stover and S. J. Wantuck, Socony-Vacuum Oil Co. Inc. It employs a catalyst composed of chromium oxide and alumina which has been formed into very hard and strong blue-coloured beads. It was shown by the authors that naphthas from many representative crudes in the U.S.A. and in S. America can all be converted into petrol of high enough anti-knock value to operate the Kettering engine. When the automotive industry makes such engines for universal use and all petrols are produced by this and other catalytic processes, as much as 25 to 35% conservation of petroleum is expected.

In addition, the catalyst was shown by the authors to make from abundant naphthas very high anti-knock components for 115/145 aviation petrol. By converting selected fractions of these naphthas, it was shown that benzene and xylene could be produced for synthetic rubber and plastics as well as toluene for explosives. As regards the naphthas which can be used and the products which can be made, both the catalyst and process are extremely versatile.

Gas from low-grade fuels

A new method of producing gas at low cost from cheap fuels, including low-grade coals, peat, lignite and heavy fuel oil, was described by Dr. Kurt Baum, Pan-European Industrial Plants, Co., Paris. The method also opens possibilities for manufacture of cheap industrial heating gas, or making synthesis gas for the chemical industry. The process involves the chemical action of finely dispersed solid carbonaceous matter, or atomised fuel oil, with air or pure oxygen and steam. The oxygen is introduced gradually, to avoid unnecessarily high temperatures and to keep slag deposits to a minimum. Practically all the ashes leaving the reaction chamber are entrained with the gas and precipitated by special devices. Any carbonaceous matter, or even heavy fuel oil, is reacted in suspension with air or oxygen and steam in an incomplete combustion method, and a gas rich in carbon monoxide and hydrogen is thereby produced by a continuous process at a very low price, especially when large units are employed.

Coking and low-volatile coals with a strongly reduced carbon reactivity have been successfully processed, but no complete reaction was obtained as long as temperatures were limited within a range where slagging does not occur. The residual semi-ash dust as discharged can be easily burned as boiler fuel with surplus air, so that in combination with a boiler house or power station 100% carbon utilisation is possible.

The conversion of a carbon monoxide and hydrogen mixture, sufficiently free from nitrogen, into a high-grade gas as replacement for natural gas by methanisation is a problem of distinct interest at present in certain regions far from natural gas supply sources. A further application might be the use of such gas for the direct reduction of iron ores, a problem of special interest due to the heavy drain on coking coal reserves.

Photo-sensitive glass

A new kind of glass which can be precision-machined through the use of ultraviolet light, heat and hydrofluoric acid to form intricately cut patterns of any desired shape and depth was described by Dr. S. D. Stookey, Corning Glass Works, New York. The new glass is the latest in a series of photosensitive compositions first announced by Corning in 1947 to produce permanent three-dimensional photographs in glass in a variety of colours. To the new composition, which is a special kind of photo-sensitive opal glass, an equally new process of ' chemical machining' has been adapted. This process, without the aid of mechanical tools, produces lace-like patterns hitherto considered impossible in glass.

The first step in the process is the printing of a design in the glass, using an ordinary photographic negative and ultraviolet light.

Development is then accomplished by heating the glass to 1,200°F. for the required time, usually about 2 hr. At this stage, a milk-white image appears in the otherwise transparent glass.

The glass is then immersed in a solution of hydrofluoric acid until the white areas are eaten through and removed, leaving the remaining unexposed glass in the exact form of the original pattern.

By varying the length and intensity of light exposure through the photographic negative the depth of acid penetration in the glass can be accurately controlled from shallow etching to complete erosion. In this way, sculptured figures or contoured shapes can be made by using a continuous tone negative with proper degrees of shading.

Since chemical machining involves no mechanical stress, patterns which would otherwise be too complex to reproduce in glass or any other material without long and tedious work by skilled craftsmen can be simultaneously reproduced in any number and with photographic accuracy by this method.

Chemical machining is especially suited to perforating holes of any shape having diameters of only a few thousandths of an inch and numbering up to several thousands per square inch. Designs as irregular as lacework can be photo-etched as readily as simple straight-line patterns.

The versatility of the process has already been demonstrated in the manufacture of ' printed ' electrical circuits for electronic instruments. By using a photographic negative, in a single operation, a sheet of glass is cut into multiple pieces, each of proper shape and size and each having identically etched circuit patterns and holes for fastening to a chassis. The pattern thus photo-engraved in each piece of glass is filled with conducting metals to form an electrical circuit of high precision and durability.

While exploration of the possible commercial uses for this new chemically machined glass has only begun, it appears certain that the product will hasten important further advances in the field of electronics.

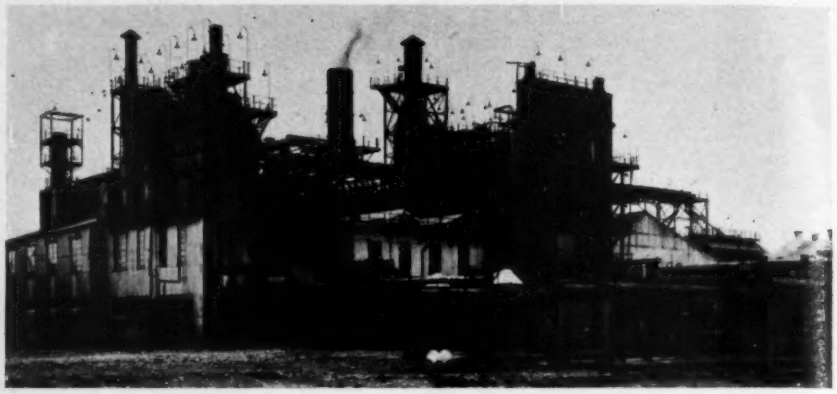
New cold rubber process

Cold rubbers, which are made at near-freezing temperatures, have been used successfully to make longer-wearing tyres, footwear and engine mountings, but difficulties encountered in processing them have prevented complete use of their serviceable properties, according to M. H. Reich, W. K. Taft and R. W. Laundrie, University of Akron. In the new method of processing cold rubber the crude rubber is mixed with other necessary ingredients in a machine called a Banbury mixer. The addition of oxygen to the rubber during mixing increases plasticity or workability, but does not adversely affect the finished product.

Investigations have shown that the plasticising, or softening, of crude rubber in the manufacturing process is not due to a mechanical action but is brought about by the addition of oxygen. Several other methods were devised to overcome the difficulties of fabricating low-temperature rubber products, but most of these methods increased production costs or lowered the quality of the finished products. Road tests using tyres made by the new method have indicated the rubber products have superior crack resistance without lowering tread life.

Philblack in Operation at Bristol

TWO types of carbon black are being produced at a total rate of 50,000,000 lb. p.a. at the new oil-black plant built by Head Wrightson Processes Ltd. for Philblack Ltd. at Avonmouth, Bristol. As pointed out in our preliminary description of the plant in our December 1950 issue, this is the largest carbon black factory outside the U.S.A. It comprises two units : one has a capacity in excess of 30,000,000 lb. p.a. of *Philblack 'O,'* a high-abrasive black for tyre treads and belting ; the other has a capacity of 20,000,000 lb. of *Philblack 'A,'* a medium reinforcing black for tyre carcasses, cable sheathing, rubber boots, etc.

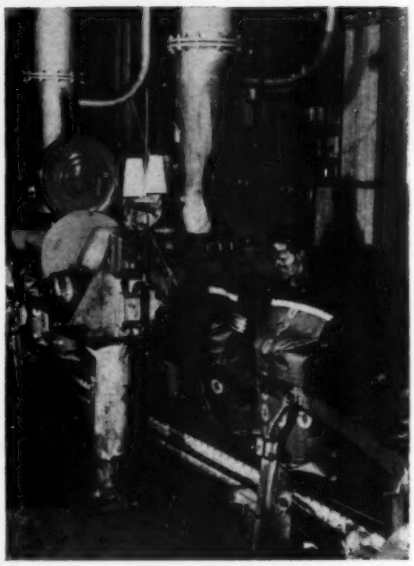


A general view of the oil-black units at Avonmouth. The 'A' unit is on the left. In the foreground are the cooling pipes which form part of the furnace system.

The pelletising mills in which the carbon black is densified.

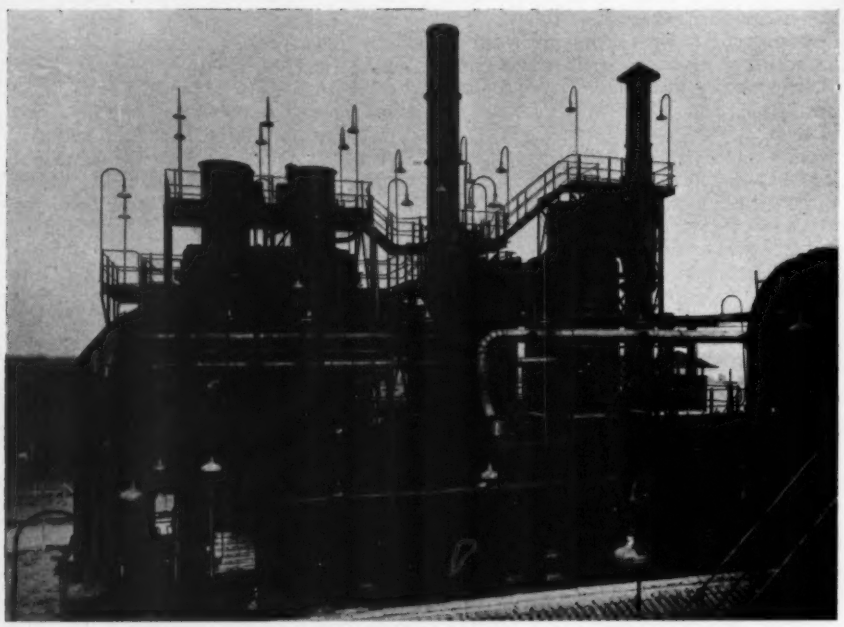
These two blacks are made under licence from the Phillips Petroleum Co., U.S.A., by the Philblack process. The whole of the capital required was raised in the U.K. and the management and staff are all British. Approximately 70,000 tons p.a. of a special petroleum fraction are needed to keep the two units in full production. The petroleum fraction used at present comes from the U.S., but it is hoped eventually to obtain it from U.K. refineries. The only other raw material required is a large and steady supply of compressed air. This is provided by three triple-stage direct-coupled air blowers, each powered by a 550-h.p. motor.

The commercial production of a good reinforcing black from a petroleum fraction in a specially designed furnace plant was only started by Phillips in the U.S.A. in 1943, after an expenditure by them of over £1,000,000 on development work. Moreover, *Philblack 'O,'* the prototype of modern super reinforcing blacks, was not produced until 1947 after continued research. The project at Avonmouth was developed directly from the results of the Phillips research work and the British company can still draw on the technical resources of the American licensers for fundamental research.



Sewing up the multi-sheet paper bags of carbon black.

In addition to the two process control laboratories at Avonmouth, new laboratories have been erected at Newbury by the company's sole selling agents, R. W. Greeff & Co. Ltd., for research and development work on the applications of *Philblacks* which, although used mainly in the rubber industry, are being increasingly employed in the paint, ink, paper, textile and other industries.



Part of the Philblack 'A' unit.

New Oil Refinery in the Canaries

A COMPLETELY new refinery for the production of high-quality lubricating oils and waxes went on stream at Teneriffe, Canary Islands, in January last. The refinery is owned by the Compania Española de Petroleos (CEPSA). There are five groups of islands in the Canaries and, while Gran Canaria is probably the leading island, the Teneriffe group is almost of equal importance and has achieved new distinction with the start-up of this modern petroleum refinery.

According to a description in *Heat Engineering*, published by the Foster-Wheeler Corporation Inc., designers and builders of the plant, the refinery had its beginning in 1930 when simple crude distillation was the major process. In 1935, thermal cracking was added and now in 1951 there are complete facilities for the production of high-grade lubricating oil. This latest addition to the refinery comprises a two-stage crude distillation unit of 5,000 barrels/day capacity, a furfural refining unit, an MEK-Benzol solvent dewaxing unit, a propane de-asphalting plant, and clay percolation for the filtering of the various lube oils to colour specification. A de-asphalting plant has also been added for the separation of asphalt from residue, leaving a de-asphalting stock which can be processed as a lubricating oil stock for the eventual production of bright stock, a high-viscosity lubricating oil.

Two-stage crude distillation unit

This two-stage crude distillation unit was designed to process 5,000 barrels/day of two widely different types of crude, *viz.* a 34.9 A.P.I. gravity Arabian crude or an 18.1 A.P.I. gravity Venezuelan crude. Further design flexibility is indicated in the fact that the atmospheric section of the unit may process the lighter gravity Arabian crude while the vacuum section is processing reduced Venezuelan crude. Adequate ranges of capacity for pumps, coolers, condensers, etc., were necessary in order to accommodate such variation in quality of charging stock. Lubricating oil distillates can be produced from both the Arabian and Venezuelan crudes, and the Venezuelan crude is a very good source of high-quality asphalt which can be marketed as such or blended for the production of the various road oils and cutbacks. A production of 1,000 barrels/day of lube distillates (20% on the crude) from the vacuum column when running the Arabian or Venezuelan crudes was planned as adequate for the final quantity of lubricating oil to be produced. The residue from the Arabian crude, containing considerably less asphalt than the residue from the Venezuelan crude, represents the stock that will be de-asphalted in the propane de-asphalting plant for the production of high-viscosity lubricating oils.

One overhead and four side-streams can be removed from the atmospheric tower; in the vacuum stage, four side-streams represent the fractional separation of the reduced crude and there is also provision made for a slop cut between the heavy lube fraction and the residue itself.

The atmospheric column is 7 ft. in diameter and 87 ft. high; the vacuum column is 8 ft. in diameter at its widest point and is 55½ ft. high. The direct-fired heaters are of standard Foster Wheeler design and have the duty of vaporising the light fractions of the crude in the atmospheric stage and the heavy fractions, including the lube fractions, in the vacuum stage. The normal duty capacity of the atmospheric heater is approximately 17,000,000 B.Th.U./hr. and the vacuum unit heater is about one-half that rate. Each heater is equipped with a steam superheater for the production of superheated process steam to be used in both atmospheric and vacuum columns and in side-stream strippers.

Description of flow. The crude oil absorbs heat at three points in the crude distillation system through heat exchange in the following sequence:

(*a*) Vapour heat exchanger atmospheric overhead;
(*b*) Atmospheric gas oil from bottom of side-stream stripper;
(*c*) Vacuum residue bottoms.

The preheated crude then enters the flash drum where there is a separation of vapours produced during the preheating. These vapours enter directly into the atmospheric column. The flashed crude enters the atmospheric heater and is raised to a temperature of 635°F. and then passes as a mixture of vapour and liquid into the atmospheric column. The overhead, a light gasoline, is condensed and cooled and accumulates in the small accumulator tank. A pump draws on this tank and moves the gasoline both to storage and through a sideline back to the column as reflux. The four side-streams are removed from the column and flow into the side-stream stripper where they are stripped of their very light components and leave the stripper and are cooled and are then pumped to storage.

The reduced crude from the bottom of the atmospheric column is pumped directly to the smaller direct-fired heater and sufficient vaporisation takes place in there to provide for the removal of the heavy gas oil and various lubricating distillates in the vacuum column. Only uncondensable vapours and steam pass from the top of the vacuum column through a steam-jet ejector system which provides the necessary vacuum on the column itself. All petroleum products are condensed in the column. Product heavy gas oil is removed as a liquid from the top of the column and passed to an accumulator tank from which portions are returned to the column for reflux and temperature control. The other side-streams and bottoms are rem ved from the column by pumps and are cooled and moved to storage.

Furfural refining unit

This important process unit for the refining of lubricating oil consists of four major sections:

(*a*) A vertical counterflow treating tower containing several sections of Raschig rings and especially designed redistribution trays installed to ensure intimate contact between the up-flowing oil on down-flowing solvent. Heat exchangers and intercoolers are provided to maintain the proper treating temperatures throughout the towers.

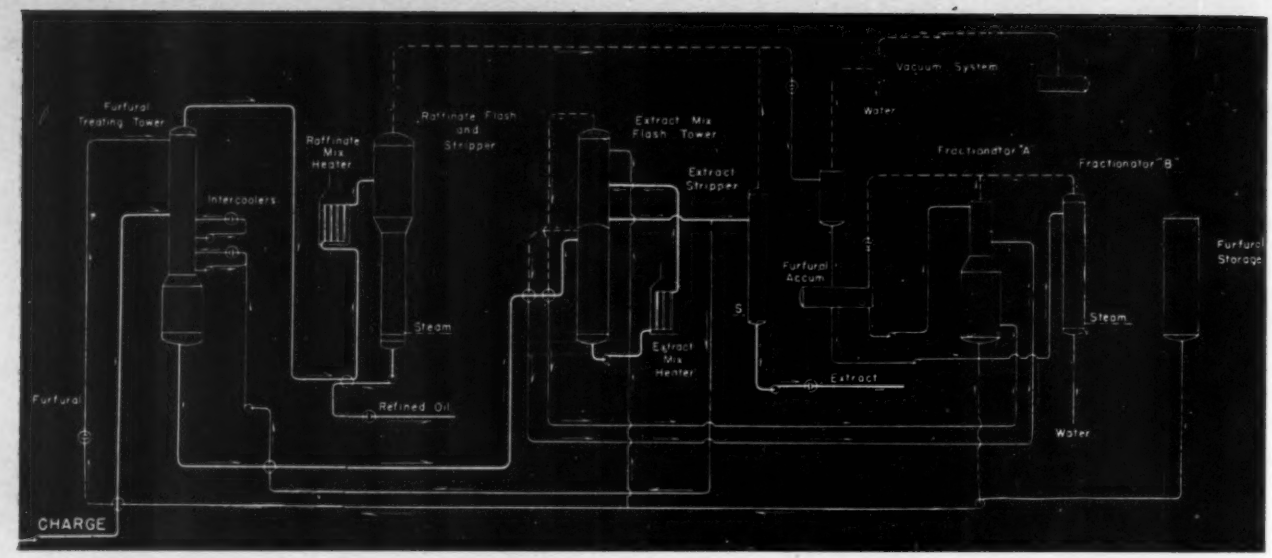
(*b*) A refined oil recovery system consisting of a direct-fired heater, a vacuum flash and stripping column and heat exchangers as necessary for the economical recovery of solvent from the refined oil.

(*c*) An extract recovery system consisting of a double-effect evaporator system and a vacuum steam-stripper to remove all traces of furfural from the extract.

(*d*) A furfural recovery system comprising two towers known as 'A' and 'B' fractionators to remove from the unit any water entering as stripping steam or with the charge oil.

Description of flow. Referring to the accompanying flow diagram, it may be noted that the charging stock enters the unit through a heat exchanger in which it is heated by exchange with hot recovered furfural. The temperature of furfural entering the column is further controlled by a cooler. Both the charge oil and the furfural enter the column at pre-determined temperatures through separate lines and at separate locations. Countercurrent contacting takes place in the treating tower in which a uniform temperature gradient is carefully maintained. In this column furfural selectively extracts the undesirable material from the charge stocks. Refined oil containing a small percentage of furfural flows from the top of the column through a heater to a combined flash tower and stripper wherein the furfural is removed from the oil. The furfural leaves this tower as a vapour which, together with the steam used for stripping, is condensed and flows to an accumulator for the subsequent removal of water in the 'A' and 'B' fractionators. The refined oil is pumped from the bottom of the raffinate stripper to storage.

The material which has been extracted from the charge oil is carried in furfural solution from the bottom of the furfural-treating tower through a series of heat exchangers to a primary flash tower in which a portion of the furfural is vaporised. The liquid remaining in the bottom of this flash tower is pumped through a heater to a secondary flash tower in which all but



Flow diagram of furfural unit.

a fractional percentage of the furfural is removed from the extract. For the removal of the last traces of furfural, the extract flows to a steam stripper from which the furfural-free extract is pumped through exchangers to storage. The extract, comprising hydrocarbons and other materials which are undesirable in high-grade lubricating oils, are frequently burned as fuel oil or charged to cracking units, but occasionally is reprocessed for the production of aromatic products. All dry furfural vapour is condensed and collected in an accumulator for recharging to the treating tower. All furfural-water vapours are condensed and collected in a separate accumulator for the subsequent removal of water in the 'A' and 'B' fractionators.

Solvent dewaxing unit

The refined oil from the furfural refining unit is charged to a solvent dewaxing unit, where wax is removed in order to produce lubricating oils having the desired degree of fluidity at low temperatures. The unit is also designed to reprocess the wax removed in the dewaxing operation in such a way as to separate the oily low-melting wax fractions from the higher-melting-desirable waxes which then comprise a product of high quality. This process unit consists of the following main sections: (*a*) ammonia compression refrigeration section; (*b*) charge oil and solvent mixing and chilling section; (*c*) vacuum-filtered wax removal section; (*d*) dewaxed oil recovery section; and (*e*) slack-wax recovery section.

Dilution solvent is added to the charge oil, after which the solution passes through double-pipe scraped surface heat exchangers and chillers in which the temperature of the solution is reduced to filtering temperature. The chilled mixture containing crystallised wax flows through a filter feed tank into the vats of the dewaxing filters. Inside each of the filters is a rotating cloth-covered drum in which a vacuum is maintained. The oil-and-solvent solution, free of wax, is drawn through the filter cloth and flows from the filter to a receiver from which it is pumped to a primary flash tower of the dewaxed oil recovery section. The liquid in the primary tower is reheated and pumped to a stripper in which the remaining traces of solvent are removed by open stripping steam. The wax-free oil is then pumped to storage.

A fixed blade in the filter continuously directs the flow of wax from the rotating cloth-covered drum into a wax-mix receiver from which the mixture is pumped through heaters to a surge tank and thence through additional heaters to a flash tower in which substantially all of the solvent is vaporised. The remaining traces of solvent are removed from the wax by a steam stripper and the solvent-free wax is then pumped to storage.

The water-solvent vapour from the two stripping columns is condensed and charged to a solvent fractionator in which all water entering the unit system is separated and discharged from the system.

The dewaxing unit is designed for the production of dewaxed oils having a pour point of 0°F. The melting points of the waxes produced vary with the boiling range of the lubricating oil stocks from which they are derived; the higher melting point waxes occurring in the more viscous stock oils.

Propane de-asphalting unit

In the original plan the high-viscosity oil was to be produced from a heavy overhead distillate from the vacuum tower of the crude distillation unit; however, it was subsequently decided to install a propane de-asphalting unit so that the high-viscosity oils could be produced from the residue of Arabian crudes. This residuum, which contains approximately 40% of asphalt, is charged to this propane de-asphalting unit and the asphalt is precipitated by selective solvency, leaving a de-asphalted oil in solution which is then stripped, and the oil is subsequently furfural refined and dewaxed and clay filtered for the production of a superior quality high-viscosity bright stock.

The propane de-asphalting unit consists of a counter-current liquid-liquid extraction tower for the contacting of residual oil and propane and equipment for the recovery of the propane. The recovery equipment consists of the necessary stills, strippers, condensers, pumps, compressors, heaters, coolers and vessels. The unit has a capacity of 700 barrels/day of Arabian residue.

The residuum charge pump feeds oil to the upper part of the treating tower through a steam preheater. Liquid propane is fed to the lower part of the tower by a charge pump which takes suction from the propane receiver. Steam heating coils in the upper part of the tower provide a temperature gradient in the treating tower and the propane-de-asphalted oil mix leaves the top of the tower and flows to the recovery section. The asphalt-propane mix leaves the bottom of the tower and is pumped to its own recovery system.

The propane-de-asphalted oil mix is heated and partially evaporated by exhaust steam and is flashed into the evaporator tower. The bottoms of this evaporator tower are reboiled with high-pressure steam and then passed to the stripper tower for final steam stripping under atmospheric pressure. The stripped de-asphalted oil flows from the bottom of the stripper through a cooler to storage.

The asphalt-propane mix is heated and evaporated in a direct-fired heater and flashed into the asphalt-propane mix

(*Concluded on page 590*)

Storage of Coal

Coal is an increasingly expensive raw material of industry and consequently much more attention is being paid to its storage and handling within factories than hitherto. L. G. Lockett, M.Inst.F., gave a paper on the transport and storage of coal earlier this year before the Institute of Fuel. Below is an abstract of that section dealing with the storage of coal.

ON arrival at the consumer's premises, coal has to be unloaded from truck, barge, steamer or lorry into bunkers or into storage, and the methods employed must necessarily differ. As a rule, rail-borne coal is shovelled out by hand when the consumption is small, and grabbed or tipped when large quantities are involved. When the coal is grabbed the speed of discharge is governed by the length of lift and the distance of travel, and one or two trimmers are required in the wagon. A discharging rate of 45 tons/hr. or even more should be achieved under favourable circumstances, but this would not suffice for those consumers requiring delivery at the rate of thousands of tons per day.

Reception of every 1,000 tons involves the clearance of nearly 100 wagons and the solution has been found in the development of various methods of tipping the wagons themselves to an angle which will allow the coal to flow out.

Many variations of these tippers have been evolved, some of which eliminate the necessity of all trimming except in the case of very wet and sticky fines. An example is the rotary tippler, in which the wagon is revolved on its longitudinal axis to the extent that is necessary to cause the coal to flow out; the coal is discharged just above ground level into a pit. An alternative to the rotary tippler is the side-discharge tippler, where the wagon is rotated on its external axis instead of on its longitudinal axis, which has the effect of raising the wagon in the air and discharging the coal well to the side of the track on which the wagon itself is standing, and at a height of 6 to 8 ft. above ground level. This method can be adapted for discharge at considerable height above ground by combining it with a tippler hoist which raises the wagon before it commences to rotate. Both the latter variations can effect considerable saving in the cost of excavation for the hopper. The side tippler can also be constructed in mobile form to allow for discharge at any point alongside the railway track.

When the quantity to be handled does not justify the capital outlay necessary to install a completely self-emptying tippler there are two alternative methods—a tilter or a semi-tippler. The former tilts the wagon sideways to such an angle that when the side door is opened the coal will flow out, but complete clearance is only effected with a certain amount of trimming by hand. The semi-tippler rotates the wagon through 90° with the side door closed and enables the wagon to be cleared by hand but with the minimum of labour.

The discharge of coal from vessels, whether barge or ship, is normally done by grab, although occasionally suction plant is used. The size of the grab depends on the size of the ships usually discharged at that particular berth, and the grabs are operated either from transporters or jib cranes. Experience has shown that jib cranes are more mobile and quicker than transporters for this work when discharge is mainly to barge, railway wagon or conveyor belt. Large consumers, such as power stations, gas works and large factories, are laid out in such a way that, whether coal is discharged from vessel or tipped from wagon, it is taken by conveyor to bunkers, etc., or to storage as required.

Stocking coal

In laying out a works, insufficient consideration is often given to the need for ample coal storage. The ideal to be aimed at might be described as a tactical reserve and a strategic reserve. Both should be situated so that they can be fed from the normal point of reception without difficulty and designed so that re-delivery can be made to the conveyor system feeding the bunkers without unduly interfering with the normal day-to-day functioning of that system. The object of maintaining a tactical stock is to meet day-to-day fluctuations which are inevitable as a result of fog and snow, gales, stoppages due to labour disputes, diversion to high-priority markets, colliery breakdowns and similar interruptions.

This tactical reserve should essentially be situated at a point where delivery to and withdrawal from stock can be easily effected, and the method of doing this varies from the small consumer to the very large consumer with a complete conveyor system serving both bunkers and stock as required. In the latter case the site would probably be laid out with the tactical reserve between the point of reception and the bunkers.

As the tactical stock is small relative to the annual consumption and as coal is probably fed to the stock and withdrawn again several times (or even many times) in the course of a year, this stock can be carried in a comparatively small area.

This question of stocking is of equal importance to the small consumer to whom space is a serious problem and who does not have a turnover which would warrant large capital expenditure in installing mechanical handling. Often in these cases a little thought combined with a modest outlay can bring about a great improvement. Too often one sees stock laid down on unprepared ground and with wasteful extravagance in the use of space. Haphazard tipping of lorry loads means that less coal can be tipped in a given area and leads to inaccuracy in the checking of the quantities in stock. Also recovery is more difficult, resulting in considerable short weight on the stocks put down.

A firm floor, preferably concrete, is most desirable, with some kind of bays to contain the coal. Bays with brick walls are probably best, but they are not essential, and materials such as old railway sleepers have been successfully used. Important points are that, with bays less area is required, there is no loss from coal becoming mixed with the floor, the estimating of stocks is simplified and several different varieties of coal can be stocked separately.

As regards strategical stocking there is a difference in that this stock is only picked up in time of exceptional shortage and is not a day-to-day reservoir as in the case of tactical stocking. It would not normally be picked up more than once a year and quite possible it would not be picked up for three or four years. Under these circumstances it need not be in such close proximity to the consuming point and the distance may even be a matter of some miles, provided transport to the consumption point is simple and not liable to interruption.

It will be appreciated that the cost per ton for putting-down and picking-up this strategical stock would be extremely high if expensive mechanical handling is installed for use only once a year, or even at more infrequent intervals than that. It is therefore necessary for the handling in and out of this strategic stock to be carried out with plant which is as low as possible in capital cost.

Precautions against fire in stocks

Whatever method of landing coal and picking it up again is employed, there is the ever-present problem of over-heating. When coal is exposed to the atmosphere it absorbs oxygen, and heat is generated as a result. If this heat cannot escape the coal oxidises more and more rapidly as the temperature rises until it ultimately may become so hot that it ignites. When coal is first stored the temperature usually rises to a certain level, which may be a critical level. If such a temperature is not reached by the end of about eight months and the temperature has started gradually to subside there is little risk of further trouble. If, however, the critical temperature is reached (this temperature is usually between 130 and 170°F.), it is

dangerous to neglect to take precautions forthwith, as a fire is almost inevitable and is likely to spread. In these circumstances the generally accepted method of dealing with the trouble is to dig a hole, trench or valley in an endeavour to expose the seat of the fire, and then scatter or use the hot coal. A crane or grab is almost essential in carrying out this work, and spraying with water is unlikely to prove effective.

Knowledge of how to deal with overheated coal is not, however, sufficient, nor is it as valuable as knowledge of how to prevent, or at least to anticipate, the actual outbreak of fire. The first consideration is the type of coal to be stocked. Sized coals containing a very small percentage of fines are generally accepted as being the most satisfactory for stocking purposes. It should be possible to keep this class of coal at a safe temperature by ventilation. When, however, any appreciable percentage of fines is included in the coal, ventilation is no longer effective and measures of an exactly opposite nature are necessary. Ventilation in such circumstances must be prevented as completely as possible so as to reduce the rate of oxidation.

Fire hazards

It will be apparent from the foregoing that mixture of size grades is the worst possible type of coal to stock, allowing, as it does, free passage of air through the portion of the stock where the larger sizes are, thereby causing oxidation, whilst at the same time the small sizes hinder the complete passage of the air, which would have had a cooling effect on the entire heap. In all heaps of coal, except the most closely graded sizes, there is a tendency for coal to run into pockets of the larger sizes. This, of course, increases the risk of fire in the heaps and, as a result, it is now accepted by most people that of the two methods of minimising the risk of firing, ' sealing off ' is very much preferable to ventilating.

It is unusual to experience fires in small heaps, at any rate up to at least 150 tons, and up to the height of 6 to 8 ft. the risk is small. In order to stock coal safely in large tonnages the best method is to consolidate the stock heap by rolling down the coal as it is landed. It is unusual for heating to increase after the coal has been laid down for eight months and, in view of the fact that 6 ft. is generally accepted as a perfectly safe height, an excellent method is to build up a succession of layers.

It is an advantage, but by no means always feasible, to have a low wall round the storage area to prevent draughts in the base of the skirt of the heaps. The stocking area is filled to a height of 6 ft. and the coal well rolled down to reduce ventilation. Should heating not have occurred at the end of seven or eight months, a second layer can be superimposed on the first layer, which is not now likely to fire, and again be well rolled down. In this way a high stack heap can be built up with the minimum risk.

Checking temperature of heaps

During the building of the stock heaps metal rods are inserted in the heaps, or, better still, hollow pipes, into which thermometers can be inserted. The metal rods provide a rough guide, by feel, as to whether the coal is heating, and should be inspected every few days until the danger is passed. When thermometers are used, and this is very much more reliable, readings should be taken at regular intervals and a record kept. A slow steady rise in temperature is to be expected, but a rapid rise is a sure warning of overheating, which will almost certainly result in a fire. Although water is not usually effective in dealing with an outbreak of fire, it can be useful during the process of putting stock down as it helps to pack the coal more tightly.

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Melting and Solidification of Fats

THE first two chapters of this book* deal with theoretical considerations and laboratory techniques. Mr. Bailey starts from scratch: structure of fatty molecules and glycerides, crystals, *x*-ray diffraction, solid solutions, nucleus formation; determination of melting points by various methods, dilatometric methods, cloud tests and measurements of consistency are some of the sub-headings. In these chapters Mr. Bailey reveals himself as a first-class physical chemist, besides being a competent fats technologist and chemist, as shown by his two earlier books. His treatment of the baffling problems of hydrogen bonding and the part this plays in the formation of fatty acid crystals, and particularly of compound crystals, is lucid. So is his reasoning that leads him to reject the older theory of melting and to adopt the modern view. According to this, melting of long-chain compounds is by no means the sudden process assumed by classical theory.

The next two chapters deal with melting and solidification of pure compounds and of mixtures respectively. Crystal structure, polymorphism, phase diagrams of binary and ternary systems, *x*-ray data and other aspects are discussed. There is no fundamental difference between a melt and a solution. But for convenience, solutions of fats in non-fatty materials, *i.e.* organic solvents, are treated in a separate chapter.

Having read so far the practical man in industry may perhaps pause and ask himself: ' What is the use of all that theory to me ? ' But if he persists his patience will be amply rewarded by pages 222 to 238 and by the last chapter entitled ' Practical Melting and Solidification Processes.' Here is a wealth of information on consistency, composition and plasticity of animal and other natural fats, lard, shortenings, margarine and similar products. Hydrogenation, mechanical working, persistent supercooling and other factors influencing the properties of the finished product are explained. There is a great number of dilatometric curves and also composition tables of actual branded products. Mr. Bailey has the gift of leading the reader securely along the straight road to knowledge which with a lesser guide would be a tedious struggle through a jungle of theoretical physical chemistry.

The book is remarkably up to date. It contains a reference (p. 119) to the April issue of the *Journal of the American Oil Chemists Society*, and was available some five months later in London. But Mr. Bailey surpasses himself by quoting from a journal in 1954 (p. 123) ! However, there are not more than the usual number of misprints (p. 73, fomation for formation; p. 300, of for or) and a little confusion on the top half of p. 304 referring to Fig. 133. There is also inconsistency in the form in which the references are given, *e.g.* compare reference 45 with 46 on p. 155, but these are but minor blemishes in an extremely important work, which is much needed in the industry and is bound to have a great influence.

M. K. SCHWITZER, A.M.I.CHEM.E.

* *Melting and Solidification of Fats*, by Alton E. Bailey. Interscience, New York, London, 1950, pp. xiv + 357, 150 illustrations, 56s.

Oil Refinery

(*Concluded from page* 588)

evaporator tower. The asphalt bottoms then pass to a stripping tower for steam stripping under atmospheric pressure and the stripper bottoms are pumped directly to storage without cooling.

The propane vapours from the evaporator towers are condensed directly and returned to the propane receiver. The steam and propane vapour from the strippers go to a jet condenser and knock-out drum and are compressed before being returned to the asphalt-propane mix condenser.

Contributions

THE EDITOR *welcomes practical articles and notes on chemical engineering and industrial chemical subjects with a view to publication. All contributions, which should be fully illustrated whenever possible, are carefully considered. A preliminary letter or synopsis is advisable. Address such material to* THE EDITOR, INTERNATIONAL CHEMICAL ENGINEERING, 17 Stratford Place, London, W.1.

New Plant and Equipment

Chemical glassware

A few years ago 20-litre glass flasks were considered to be very large vessels, both by the manufacturer and the user. More recently, production of 200-litre flasks has been started on a commercial scale by Quickfit & Quartz Ltd. This size is thought to be the largest ever made and it is claimed that it will make a valuable contribution towards increasing the scope of industrial chemical plant, particularly in manufacture of drugs and fine chemicals.

New plate heat exchanger

It has generally been assumed by designers of plate heat exchangers, that the rate of heat transfer depends to a great extent on a particular design of the metal plates, and it has usually been accepted that this factor in the plate design which influences the rate of heat transfer is connected with the phenomenon of turbulence. Therefore, designers aim at breaking up the plate surface by corrugations, to create a high degree of turbulence in the flow of liquid with a view to obtaining a higher rate of heat transfer.

The Creamery Package Mfg. Co. Ltd., dairy engineers, have investigated the problem theoretically and experimentally and have come to the conclusion that the effect of plate design on the rate of heat transfer is *not* connected with turbulence but is accounted for by uneven distribution of liquid flow over the plate surface, which arises as a result of flexing of the plates and air pockets in the flow channels.

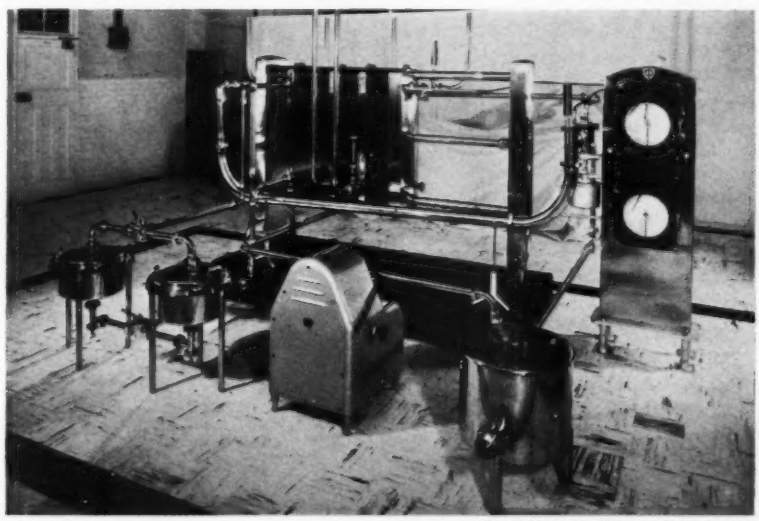
These conclusions have been embodied in a new stainless steel multi-pass heat exchanger recently introduced by that company. This plant has completely plain and flat stainless steel heat exchange plates, which principle is ideal from a cleaning point of view, besides minimising the formation of milk stone and forming a perfect surface for sealing.

An innovation of great importance in practical operation is the complete elimination of adhesives which are always unsatisfactory for maintenance (usually plate heat exchangers have gaskets attached by adhesives to metal plates for sealing, and when the gaskets do not fit perfectly, the crevices form a constant source for bacteria growth). The new C.P. seal, however, is moulded from organic materials and is a loose unit, specially designed to give uniform support throughout its surface to the heat exchange plates, obviating flexing of the plates and ensuring even distribution of the processing, heating and cooling media. The seals are easily detached and can be immersed in a detergent bath whenever desired if cleaning by this method is preferred to pumping detergent through the press and subsequent brushing. Any seal can be easily replaced should it become damaged, and as no adhesives are used, a simple exchange can be made in a matter of seconds.

The designers have also incorporated a special air venting arrangement in the seals and in certain of the heat exchange plates, which ensures that air pockets are withdrawn from the liquid stream going downwards, into the next liquid stream flowing upwards, and air is thereby carried away with the liquid stream, thus forming an automatic air venting system.

It is claimed that this new plate heat exchanger incorporating detachable seals, gives the maximum rate of heat transfer for a given pressure drop and this maximum value is within a few per cent. of the theoretical value corresponding to the ideal case of perfectly uniform distribution of liquid flow over the plate surface.

The exchanger has been designed primarily as a high temperature, short time pasteuriser for milk, but it is suitable for many other purposes demanding efficient heat exchange.

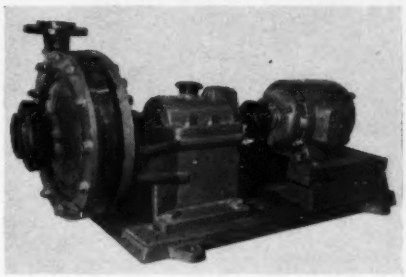


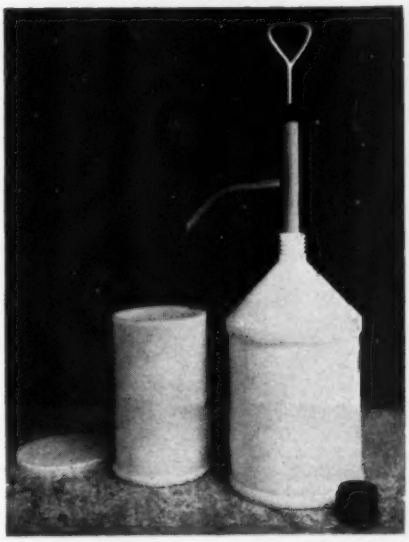
[Photo: Creamery Package Mfg. Co. Ltd.

New stainless-steel plate heat exchanger.

Plastic chemical pumps

In the handling of corrosive liquids the pump is sometimes the weakest link in the whole installation, although a whole range of acid-resistant metal and ceramic pumps are available nowadays. For a number of years, pipelines and tank linings for the chemical industry have been fabricated in a variety of inert, corrosion-resistant plastics. Now, rigid polyvinyl chloride and reinforced phenolic resin pumps are being manufactured for the chemical industry by Rediweld Ltd.

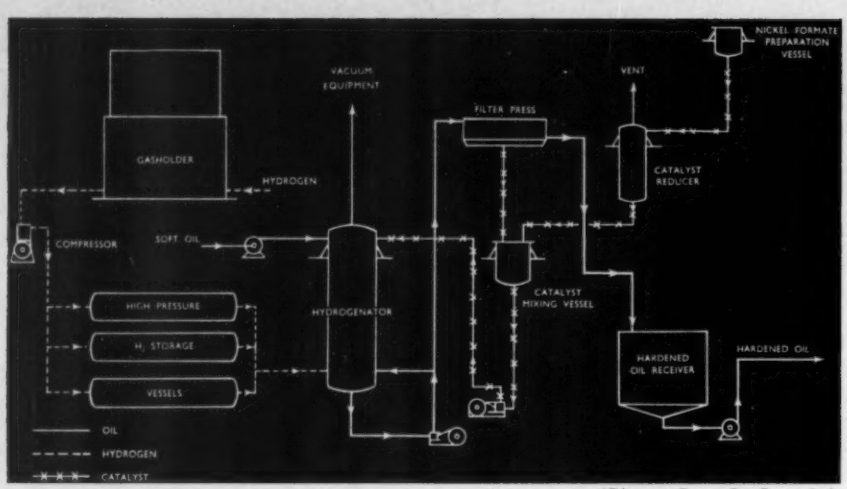




Above : **One of a range of centrifugal pumps in which all parts in contact with acid are of plastic or plastic-covered metal.** *Below :* **Small hand-operated valve-type piston pump in PVC.**

Photos: Rediweld Ltd.

Three different types of PVC pumps are being produced : a small hand-operated valve-type piston pump for discharging carboys, a hand-operated diaphragm-type pump for lifting corrosive liquids up to a head of 60 ft., and a range of centrifugal pumps fabricated either in



[*Diagram: Power-Gas Corpn. Ltd.*

Flow-sheet of hydrogenation plant for the hardening of vegetable and animal oil.

rigid PVC or phenolic material. The output of the centrifugal pumps varies from a minimum of 8 gal./min. to a maximum of 1,800 gal./min. Their construction closely resembles the orthodox design of metal centrifugal pumps which have been used in the chemical industry for many years, the difference being that all parts in contact with the acid are either fabricated from corrosion-resistant material or made in metal but completely enclosed in plastic. Most of these pumps are available for delivery from stock.

Oil processing plant

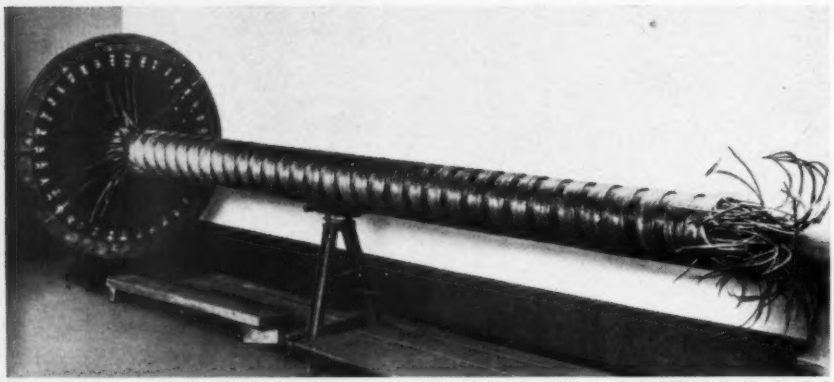
In the process of hydrogenation the melting point of a liquid oil is raised to render it suitable for the manufacture of an edible or technical fat. This is done by allowing the oil to absorb hydrogen gas by catalytic reaction under suitable conditions of temperature and pressure. The P-G hydrogenation plant marketed by the Power-Gas Corpn. Ltd. for the processing of vegetable and animal oils is claimed to be particularly suitable for the manufacture of margarine, cooking fat, shortening, vanaspati, etc. The plant is provided with comprehensive equipment for the production of a highly active catalyst from nickel formate under automatically controlled conditions. A batch of catalyst may either be used repeatedly until it is 'spent,' or a proportion may be discarded from time to time and replaced by fresh material. During the hardening process the three phases of catalyst, oil and hydrogen are brought into intimate contact in the reaction vessel. The plant is designed to handle from three to five charges in 24 hr., depending on the type of product desired. The finished charge is cooled and pumped through a filter press, where the catalyst is removed from the hardened product.

Cross counter current heat exchanger

A novel cross counter current heat exchanger has been manufactured by Petrocarbon Ltd. It is one of several for a low pressure oxygen plant now being built in Europe and designed to produce 200 cu. metres/hr. of pure oxygen. This equipment is required to effect an exchange of heat between air and nitrogen, the air passing through the coiled tubes under a pressure of 75 lb./sq. in. and the nitrogen in the shell at a pressure close to atmospheric.

The exchanger contains a total wound length of 34,680 ft. of $\frac{3}{8}$ in. O.D., 20's g., solid drawn copper tubing in 289 separate, jointless tubes, each of which is 120 ft. long. The whole of the winding was carried out on a $7\frac{1}{2}$ in. diameter core tube giving a total surface area available for the transfer of heat of some 3,400 sq. ft.

The individual tubes are expanded into the tube plates and then flooded with solder, and the shell, fabricated from copper sheet, is suitably jointed and mounted. External dimensions are: overall length, 20 ft.; diameter, $22\frac{1}{2}$ in.

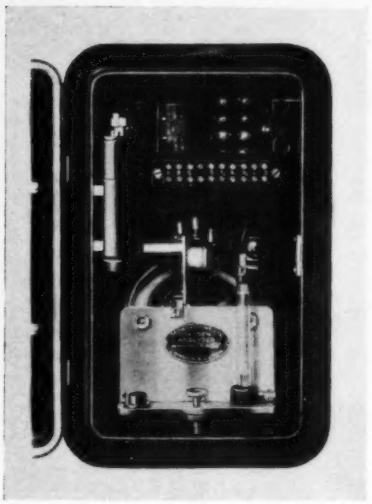


[*Photo: Petrocarbon Ltd.*

Cross counter current heat exchanger for a low-pressure oxygen plant.

Magnetic oxygen recorder

A robust paramagnetic oxygen recorder is claimed to meet all the usual industrial demands with accuracy. It is expected in many instances that direct analysis with the new instrument will replace the inferential oxygen analysis depending on the estimation of the content of other gases.



[*Photo: George Kent Ltd.*

Paramagnetic oxygen recorder.

The design of the recorder is based on the magnetic wind principle, owing its efficacy to the fact that, of the common gases, only oxygen and nitric oxide are attracted by a magnetic field. The instrument is capable of dealing with most industrial gas mixtures, but to avoid congestion of orders in the early stages, applications are initially being limited to the following ranges : 0 to 5%, 0 to 10% and 0 to 15% oxygen in nitrogen ; 0 to 2% oxygen in hydrogen ; and 0 to 2% oxygen in coal-gas. The installation is entirely mains-operated, and a constant-voltage transformer is supplied with the equipment. The primary element, the analyser, can be located at any distance up to 400 yds. from the recorder. The recorder is supplied by George Kent Ltd.

For further information on new plant and equipment, please complete the coupon on page 598.

World News

GREAT BRITAIN

Part-time chemical engineering courses

The Ministry of Education, in co-operation with the Institution of Chemical Engineers has now arranged for awards of a Higher National Certificate in Chemical Engineering. Courses are available for students who already possess an Ordinary National Certificate or Higher National Certificate in Chemistry, Applied Chemistry or Mechanical Engineering. In the former case they should extend over three years.

In order that the various technical colleges and industrial organisations may understand what, in the opinion of the Council of the Institution of Chemical Engineers, constitutes a suitable part-time course in chemical engineering for the type of student referred to above, a booklet detailing the subjects proposed for the three-year course in skeleton form and then elaborated in explanatory notes, has been published by the Institution ('A Scheme for a Part-Time Course in Chemical Engineering,' price 2s.).

The success or otherwise of the scheme depends first on demand and, secondly, on facilities. The responsibility for encouraging young people to ask for courses of the kind proposed lies mainly with the employers. It is only where the demand for courses is consistent with the shortage of chemical engineers that the technical college may with confidence embark upon the necessary steps for the implementation of the scheme. A further point stressed is that, notwithstanding the shortage of chemical engineers, chemical engineering should be taught by qualified chemical engineers.

Organising industrial research

The heads of national organisations controlling or encouraging research in industry in 11 countries met in London last month for the International Symposium on the Organisation of Scientific and Industrial Research. The countries represented were Austria, Belgium, Canada, France, Germany, Ireland, Italy, the Netherlands, Norway, Sweden, United Kingdom and U.S.A. and it is believed that never before have so many responsible organisers of industrial research met together. The number of delegates amounted to about 90.

Sponsored by the O.E.E.C., an increasing number of intra-European technical assistance projects have been organised to enable teams to see the best that European countries themselves can offer. This particular symposium followed a tour of eight European countries to study the organisation of research and methods of applying research in industry in various countries. About 16 papers were presented.

Petroleum equipment makers visit Balfour's

'British industrial firms should be less conservative and interchange ideas more, in order to help one another compete in the world markets.' Mr. T. Miller, managing director of Motherwell Bridge & Engineering Co. Ltd., said this to representatives of the Council of the British Manufacturers of Petroleum Equipment who visited the works of Henry Balfour & Co. Ltd., Durie Foundry, Leven, Scotland, recently.

He was speaking at a luncheon in reply to the welcome of Mr. W. Lindsay Burns, vice-chairman and managing director of Balfour's. Mr. Miller complimented Balfour's on giving a lead to Scottish industry by throwing open their doors to other concerns. They had placed no 'iron curtain' around their 6½-acre works, with its 1,000 employees.

The speaker felt that industrial concerns should seek to learn from one another in order to be able to face up to the increasingly keen competition in the world markets. 'We are going to have a hard struggle doing that,' he prophesied.

He assured Mr. W. Lindsay Burns and other Balfour executives that the interests of the visiting party had been greatly advanced. 'Balfour's is a very progressive firm,' he declared. 'I am sure we shall all go away very much wiser.'

Capt. G. P. Claridge, chief executive of the Council of British Manufacturers of Petroleum Equipment, told the gathering, 'I do hope you will get your own firms to volunteer to have visits in this manner. In this way the interchange of industrial ideas will be facilitated.'

During the tour of the works, considerable interest was shown in a vast milk evaporation plant being prepared for shipment to Denmark and in the preparation of Pfaudler glass-lined tanks in the enamelled metal products department.

Giant stainless-steel tanks, over 17 ft. in diameter and 20 ft. high, for distillery firms, called forth admiration of fine workmanship. The Argon Arc and Union-Melt welding methods were carefully watched, and also were weld inspections carried out by *x*-ray in the radiographic department.

Mr. Lindsay Burns, Jnr., works director, and Mr. Malcolm Hutchison, sales director, were among those who conducted the party round the works.

Tricresyl phosphate claimed to improve aviation spirit

The addition of minute quantities of tricresyl phosphate to aviation spirit to prevent the fouling of sparking plugs by deposits has been investigated by the Shell Petroleum Co. on both sides of the Atlantic, where the development is covered by pending patent applications. Added to petrol, tricresyl phosphate is thought to modify the deposits inevitably formed in the cylinders, rendering them neither electrically conductive nor corrosive to valve material, even at the high temperatures prevailing inside the engine.

In the U.S.A., successful tests have been carried out under Air Force auspices; in the U.K., B.O.A.C. will soon conduct extensive trials under commercial operating conditions. The flight test programme has been preceded by exhaustive testing by engine manufacturers, during which this chemical additive has been shown not only to reduce sparking plug trouble, but also to minimise the risk of exhaust valve failure.

Prof. Garner joins Gas Council Research Committee

Additions to the membership of the Gas Council's Research Committee are as follows: Prof. F. H. Garner, O.B.E., Professor of Chemical Engineering, University of Birmingham, and part-time member of the West Midlands Gas Board; Mr. J. H. Dyde, President of the Institution of Gas Engineers, in succession to Mr. F. M. Birks; Mr. G. Le B. Diamond, C.B.E., chairman of the West Midlands Gas Board; and Dr. F. J. Dent, Director of Research at the Council's Birmingham station.

Mr. F. M. Birks, C.B.E., deputy chairman of the North Thames Gas Board, will continue to serve on the committee.

The committee was established in September 1950 to advise the Gas Council on all matters connected with research, drawing up programmes and reviewing progress from time to time. At the time of the committee appointment only two of the three scientific members were appointed and the vacancy is now filled by Prof. Garner.

Better prices offered for uranium

Higher prices for uranium ores and concentrates—in some cases 100% higher than previous prices—are being offered to prospectors in the Colonies and Dependent territories by the Ministry of Supply. The offer does not apply in the U.K. The reasons for the higher prices are: (*a*) the general increase in prices of metals since the Ministry's original offer in March 1949, and (*b*) increased prices now offered by the U.S. and Canada.

The new minimum prices for contained uranium oxide (delivered c.i.f. to a plant or U.K. port) range from 25s./lb. for ore containing not less than 0.2% uranium oxide to 35s./lb. for ore containing not less than 10% uranium oxide. These compare with the original minimum offer of 13s. 9d./lb. of uranium oxide delivered f.o.b. ocean port.

As an additional incentive a development bonus equal to the purchase price will be paid for the first 5 tons of uranium oxide from previously unworked deposits, and capital may be provided for processing plants.

The Ministry does not guarantee to buy less than 1 ton of uranium oxide, *e.g.* less than 10 tons of 10% concentrate, or less than 500 tons of 0.2% ore. The offer is also restricted to pitchblende ores and their secondary derivatives, no guarantee of purchase being made for refractory uranium ores that cannot be treated by simple acid-leaching plants.

The Ministry is also willing to discuss purchase terms for thorium-bearing minerals.

Although Colonial geological surveys are, in general, much better equipped to provide assistance and analyse samples of radioactive ores than they were in 1949, the Geological Survey of Great Britain is continuing this service to prospectors.

Colour makers' dinner

The British Colour Makers' Association held its second annual dinner in London on November 6, the chairman of the association, Mr. H. Gosling (Cornbrook Chemical Co. Ltd.) presiding. The principal guest was Mr. Harry Jackson, joint managing director of the Dyestuffs Division of Imperial Chemical Industries Ltd.

As the result of the annual meeting of the association on November 7, the following will be the officers for the ensuing year : *Chairman :* Mr. V. Watson (Cromford Colour Co. Ltd.) ; *Vice-Chairman:* Mr. C. M. Beavis (Golden Valley Colours Ltd.) ; *Hon. Treasurer :* Mr. C. G. A. Cowan (Cowan Bros. (Stratford) Ltd.).

Polish chemical engineers

During the past four years some 387 Polish students have graduated in engineering subjects while studying at the Polish University College in London. Of these, 66 were chemical engineers and three metallurgists. The establishment of this college goes back to 1942 and the course of study followed until recently has been a Continental diploma course of 4½ years, equivalent to that for a pre-war diploma of a Polish technical university. This comprehensive course has been fully appreciated by industry and all the students who have so far graduated have obtained employment in their profession in the United Kingdom or overseas. From now on, however, the Polish students will be taking the external B.Sc.(Eng.) of the University of London, by whom they have been officially recognised since October 1949. As more and more Polish ex-servicemen and women are rehabilitated, the number of students will decline. Bearing this in mind arrangements have already been made to assimilate the engineering departments in those of Battersea Polytechnic with whom they already co-operate.

Prof. Z. D. Jastrzebski is head of the chemical engineering department of the Polish University College and most of his staff are Polish. Nevertheless, the lectures and examinations are all carried out in English.

NORWAY

Biggest aluminium plant

Construction will start soon on the new £12,500,000 aluminium plant at Sunndalsöra in west Norway. The plant will be the biggest in Norway, with an output of 40,000 tons p.a. of aluminium. The plant is being built by the same company which built the Årdal aluminium plant after the war, and construction and production experiences at Årdal are proving useful in planning the new plant. Many improved features are to be introduced at Sunndalsöra which it is expected will reduce costs appreciably. For example, provision will be made for transporting the raw material, oxide, in bulk instead of in sacks as hitherto. The furnaces will have twice the power of those at Årdal, thus reducing both construction and labour costs. There will be altogether 264 furnaces in two large halls about 600 yds. long and 150 yds. wide. From Germany 6,000 tons of construction steel have been ordered, and a Norwegian factory will supply 12 mobile cranes with a lifting capacity of 25 tons each. Converters and transformers are to be manufactured in Germany and Norway. A ten-year contract for the supply of oxide has been negotiated with Aluminium Union Ltd. of Canada. It is estimated that production costs of aluminium in the new plant will work out at just over £100 a ton.

AUSTRIA

Acetate production started

Austria's total requirements of ethyl acetate, methyl acetate and butyl acetate will shortly be covered from domestic production. A chemical factory in Krem on the River Danube is starting large-scale manufacture of these products, which were previously imported from Germany, U.S.A. and France. Another firm started production earlier this year, and the combined output should cover Austrian needs.

New steel works

The building of the VOEST (United Austrian Iron & Steel Co.) Bessemer steel works at Linz is progressing. The company's construction organisation is building a new shed measuring 75 m. by 25 m. and 75 m. high. For the time being this will house two converters which will be delivered early in 1952 by the German company, Gute Hoffnung. Each of the converters will have a capacity of 25 to 30 tons. Another converter will be added later.

The new works will start production in the second half of 1952 and annual capacity will be in the neighbourhood of 100,000 tons. The type of Bessemer steel to be produced in the Linz works is known as ' L-D ' steel, after the inventor of the Linz acid-Bessemer process, Dürrer. A second Bessemer steel works of similar size is under construction in Donawitz for the Alpine Montan Co.

Total production of the VOEST this year will comprise 220,000 tons of Siemens-Martin steel and 180,000 tons of electric steel.

FRANCE

International chemistry congress

The 24th International Congress of Industrial Chemistry was recently held from November 22-December 2 in Paris under the auspices of the Société de Chimie Industrielle. Other events held at the same time included a series of lectures on chemical engineering organised by the Centre de Perfectionnement Technique, a symposium on organic analysis and exhibitions of chemistry and of laboratory apparatus and industrial control equipment.

Papers were presented at the congress by Belgian, French, Dutch, German, Italian, Swedish and Swiss chemists. The following subjects were among those considered : ' Raw Materials,' ' Research Problems in Breweries,' ' The Chemical Technology of European Coals,' ' Education of Chemical Engineers,' ' Theories and Recent Experimental Research on Corrosion in the Presence of Liquid Media ' and ' Fundamentals of Modern Thermodynamics.'

GERMANY

More plastics made and exported

West German exports of plastic products have increased ten-fold in the past 16 months. This year, manufacturers processing plastic materials have increased their export quota from 1% of total production in January to 15% at present. A particularly marked increase has taken place in sales abroad of plastic foil and of synthetic leather, exports of which reached a value of close on DM1,000,000 for the first time in April. The May figure was DM1,500,000 and the June total DM1,700,000. Export business has best developed with Holland, the Belgium-Luxembourg Economic Union, Switzerland and Sweden. The emphasis in these direct exports is on consumer goods, especially those for daily use.

The number of workers now employed in the industry is 31,307, which exceeds the pre-war total and compares with only 15,555 in 1948.

FINLAND

First vegetable oil factory

Finland's first factory for hardening and refining vegetable oil is being built near Turku, the south-west port. It is expected to begin operations next year. Capacity will be 50 tons a day, sufficient to cover Finland's needs.

The owners are Oy Kasvioeljy-Vaextolja Aktiebolag, an organisation composed of Finland's oil-seed growers.

Machinery for the new factory was bought from Britain, Sweden and West Germany. The buildings alone cost 200,000,000 marks.

ICELAND

Nitrogen fertiliser factory

Preliminary work on the nitrogen fertiliser plant at Reykjavik is under way. The factory is scheduled to begin operations in 1953 and will produce about 6,000 metric tons of nitrogen annually. The total cost of the project, which is partly financed by E.C.A., is estimated at $4,660,000. To keep down production costs, the plant will make maximum use of low-cost hydro-electric power produced in off-peak hours.

YUGOSLAVIA

U.S. equipment for steel mills

The Government of Yugoslavia has ordered from the U.S. the complete equipment for two iron-ore-sintering plants that will increase the capacity of that country's two largest steel mills by 25%. In addition to supplying the electrical equipment, Westinghouse Electric International Co. will also co-ordinate the purchase of mechanical equipment from about a dozen American suppliers. Additional apparatus for the units will be made in Yugoslavia.

The new sintering plants are expected to increase the capacity of the steel mills at Sisak in Croatia, and at Zenica, in Bosnia, as they will permit the processing of larger quantities of iron ore in each blast furnace charge. The sintering process reduces by 25% the amount of coke required by the furnace.

The new equipment will increase by 75,000 tons of steel the annual capacity of Yugoslavia's blast furnaces, believed at present to be between 400,000 and 500,000 tons. It is expected they will more than repay their cost during the first year of operation.

New alcohol factory

Most of the equipment for a new methylated spirits factory at Prijedor is already installed. The initiative for the construction of the works came from an adjacent cellulose factory, whose sulphurous alkali waste will be the raw material for the methylated spirits. The new factory will start operation next year and will produce some 240,000 gal. of methylated spirits p.a.

MALAYA

Canning factories planned

Plans for the building of a canning and bottling plant and a sauce factory in Singapore by the Amoy Canning Corpn. (Hongkong) Ltd. have been approved by the Singapore Municipality, it is announced by the head of the Amoy Corpn. The factory, which will cost $2,000,000, will can and bottle local fruits, vegetables, fish, etc. The corporation plans to run its own farms and orchards to supply the factory. It is expected to go into operation early next year.

The company also plans to establish a larger plant at Kuala Lumpur, but this project will not be started until the Singapore factory is in production.

Commenting on trade relations between Hong Kong and Singapore, the chairman of the corporation said that Singapore was one of Hong Kong's most important markets and that most of the big Hong Kong companies wished to start branches in Singapore.

MEXICO

Newsprint from sugar-cane pulp

Nearing completion at the Gulf port of Tampico is a plant at which 20 tons of newsprint a day will be produced. The factory, which is being built near the Xicotencatl sugar mill by mill owners, will use 70% of sugar-cane pulp in the production of newsprint. Local investment in the plant is estimated at 6,000,000 pesos.

PAKISTAN

Government cement factory

A scheme for the construction of a cement factory in Hyderabad at a cost of Rs.10,500,000 has been drawn up jointly by the Central Government of Pakistan and the Government of Sind. It would have an estimated output of 400 tons a day. The cost of the project would be born in equal parts by the Central and Provincial Governments. A mission of representatives of the two Governments is to visit the U.S. and Europe in the near future to study various cement production methods there. Lime, gypsum and clay are easily obtainable in large quantities near the proposed site of the plant.

The Leonard Hill Technical Group

Articles published in some of our associated journals in the Leonard Hill Technical Group this month include :

Manufacturing Chemist—New Australian Pharmaceutical Factory ; Evaluation of Compressed Tablets ; Vignettes of Perfume History ; Analysis of Chlorophyll ; Progress Reports on Analytical Chemistry and Antibiotics.

Food Manufacture—Food Controls in Great Britain ; America's New Citrus Juice Plant ; British Cake and Biscuit Industry ; Manufacture of Maize Starch ; Effect of Ultra-Violet Rays on Flour.

Petroleum—British Refinery Expansion ; Vacuum's New Refinery in Essex ; Isle of Grain Refinery ; Fawley Refinery ; British Petroleum Equipment.

Paint Manufacture—Special articles on ' Oils.'

Atomics—Radioactive Isotopes in the Petroleum Industry ; Fission Products in Industry, Part II.

Muck Shifter—The Largest Walking Dragline.

World Crops—Application of Aircraft to Agriculture.

Textile Industries—Shirley Institute's Cotton Spinning Exhibition ; Electro-Magnetic Brakes on Textile Machinery.

Building Digest—Domestic Roofing.

INDIA

Manganese ore exports

One million tons of high-grade manganese ore have been allocated for export during the current year, according to a decision taken by the Government of India. There is no destinational control, nor any quantitative restriction on the export of low-grade manganese ore.

The Central Provinces Manganese Ore Co. is the largest manganese mining concern and is responsible for 50 to 60% of the total Indian production. In reply to a question whether, owing to lack of control over sales of manganese ore to foreign countries, an annual loss of over $10,000,000 is incurred by India, it was stated in the Indian Parliament that the Government were not aware of any such loss.

India's place as the largest supplier of manganese to the U.K. has been taken by the Gold Coast, her share now being less than 25.5% of the total, as compared with 84% in 1918. One of the reasons is the expanding stock-piling requirements of dollar countries, which attracted supplies to U.S.A.

In spite of the growing importance of the Gold Coast supply, the report from the Commerce Department of the High Commissioner for India in London indicates that U.K. manufacturers still prefer Indian manganese ore because of its better quality and high manganese content. The report goes on to say that the manganese resources in South Africa are being developed on a large scale, and the costs are stated to be much below those obtaining in India, and before long may have a considerable effect on the market prices.

Mineral deposits to be explored

Large-scale geophysical explorations on chromium, sulphur, manganese and other minerals will be made in India during the next few months, according to Dr. M. S. Krishnan, Director of the Geological Survey of India. One prospecting party will work in Shahabad, Bihar, for sulphur. Besides the field survey, a team of mining engineers will prospect for ferrous metal deposits. A five-year programme drawn up by the Geological Survey of India, involving an expenditure of more than Rs.10,000,000, will be put into commission early next year, Dr. Krishnan said.

CHILE

New copper plant

A new copper plant has been opened at Paipote, near Copiapo, 920 km. north of Santiago. The plant, built by the Allis Chalmers Manufacturing Co. at a cost of about $350,000,000, will produce 18,000 tons of blister copper, 1,500 kg. of gold and 6,000 kg. of silver p.a.

According to official estimates, Paipote will produce yearly about 160,000 tons of common and concentrated ores from over 1,000 big and small mines in Atacama

Province which, until now, have been neglected because of their low-grade output. After supplying home requirements, the surplus production of the plant will be exported mainly to Germany, against dollar payment.

CANADA

'Cellophane' plant being built

Following their re-entry into the U.S.A. and the establishment with local interests of a new venture in Australia, Courtaulds are extending their activities in Canada. A new company has been formed called T.C.F. of Canada Ltd. to manufacture transparent cellulose film and other packaging materials in close association with British Cellophane Ltd., in which Courtaulds are interested with La Cellophane of France.

Building of the new company's plant is now proceeding at Cornwall, Ontario, home of the factory of Courtaulds (Canada) Ltd., the existing rayon offshoot of Courtaulds in the Dominion. It is hoped the plant will be in production by the spring of 1953 with an initial output of 7,000,000 lb. p.a. U.K. exports of transparent cellulose wrappings to all countries in 1950 were some 160,000 cwt. with a value of £2,750,000. Courtaulds will have a majority interest in the new company, as it has in British Cellophane, which is the principal producer of transparent cellulose film in the British Commonwealth and the largest exporter of it in the world. British Cellophane itself will be a shareholder and so will Courtaulds (Canada), which is now manufacturing rayon staple and tyre yarn in the Dominion, as well as textile yarns.

In Canada the only manufacturer of transparent cellulose film hitherto has been Canadian Industries Ltd., which is associated with I.C.I. and the du Pont Co., U.S.A.

Potash deposits among world's biggest

One of the three largest known fields of potash in the world is being developed at Unity, Saskatchewan, by Western Potash Corpn. Ltd. The beds at Unity were described in 1949 by the American Institute of Mining and Metallurgical Engineers to be the most promising on the continent.

In the past few months three British industrialists surveying Canadian developments visited the field and were impressed with its possibilities. The Unity bed has been ascertained to be 11 ft. thick and to extend for at least 12 miles.

This would rank it as one of the three known largest in the world, along with Stassfurt, Germany, and Carlsbad, Mexico. The others are manually mined, but because of its horizontal structure the brine-recovery method is possible at Unity and Western Potash Corpn. is conducting tests to ascertain the economic feasibility of such recovery.

Sulphur developments

Now largely dependent on imports of American brimstone for its sulphur needs, Canada expects to increase its output of this material by 100,000 tons annually by 1952, according to an official of the Canadian Department of Defence Production. He said that Canada's dependence on the U.S. for sulphur would be substantially lessened within a year. New installations of pyrites' burners in pulp mills and increased recovery of sulphur from sour natural gas and other processes would increase the Canadian supply.

Another Canadian report on the sulphur situation states that construction has begun at Copper Cliff, near Sudbury, Ontario, of a works which will convert fumes from the smelter of the International Nickel Co. of Canada Ltd. into sulphur dioxide. This will be used in the manufacture of newsprint, sulphite pulp and other products which now depend on elemental sulphur imported from U.S.A.

The works, when completed in about a year's time, will have an initial capacity of more than 90,000 tons p.a. Each ton will replace and save the importation of a half-ton of elemental sulphur and thus, to begin with, will replace 45,000 tons of elemental sulphur, or nearly one-quarter of Canada's present sulphur imports.

U.S.A.

West's first synthetic phenol plant

The first synthetic phenol plant in west U.S.A. is to be constructed at the Richmond refinery in California by the Standard Oil Co. It will be built at a cost of about $4,000,000, and a recently developed synthesis process in which neither sulphuric acid nor chlorine is needed will be used. The decision to build the new plant reflects the growing use of petroleum chemicals and a western U.S. market of increasing value for phenol.

Chrome carbide, a new metal

Chrome carbide, a new metal, has now been fully tested and is ready for quantity production, according to Mr. K. R. Beardslee, general manager of the *Carboloy* department of the General Electric Co., U.S.A., in a paper read at the recent world metallurgical conference in Detriot. The new metal is said to be lighter than tungsten carbide and has a greater resistance to corrosion, abrasion and erosion. In addition, chrome carbide requires neither tungsten nor cobalt, both of which are strategic materials in short supply.

Sulphur from waste materials

The shortage of elemental sulphur has stimulated the development of methods for the recovery of sulphur present in many waste products.

The U.S. Consolidated Chemical Industries are investing a considerable sum in such processes. Plans are completed for a $3,500,000 plant at Baton Rouge, Louisiana, to handle the waste or spent acids of the Esso Standard Oil Co., Louisiana division, and to supply the Esso Co. with its entire sulphuric acid requirements. A new plant for the recovery of sulphur from hydrogen sulphide gas has already been constructed at Baton Rouge and 50% of the sulphur present is already being recovered from gas that was previously wasted. At present, Consolidated Chemical Industries' plants are producing 3,500 tons of sulphuric acid a day, 1,000 tons more than the 1949 output.

Three Pacific coast pulp and paper companies, Crown Zellerback Corpn., Rayonier Inc., and Soundview, plan to develop an auxiliary supply of sulphur in Wyoming for their pulp production. The project involves the use of hydrogen sulphide bought from the Seaboard Oil Co., Delaware, and the daily capacity will be 100 tons.

A little-used process to recover sulphur from iron pyrrhotite (magnetic pyrites) has been revived by the Brown Co., Berlin, New Hampshire, one of the largest pulp- and paper-making firms in north-east America. The company is building a $500,000 plant to process copper-mine wastes from the Vermont Copper Mine at Stratford. The firm has contracted for the delivery of 27,000 tons of waste p.a. and expects to extract the equivalent of 9,000 tons of sulphur.

Sulphur supplies controlled

The Defense Production Administration is to issue orders which will restrict the use of sulphur in the production of sulphuric acid or carbon bisulphide and also the use of sulphuric acid and carbon bisulphide in the manufacture of a considerable number of products. Use of sulphur for the production of sulphuric acid and carbon bisulphide is expected to be restricted to 90% of each producer's use of sulphur for these products during the calendar year 1950, except for certain specified highly essential industries.

The use of sulphuric acid will also be restricted to 90% of 1950 use in the production of a considerable number of products, among them aluminium sulphate, synthetic detergents for non-industrial uses, zinc and titanium pigments, cellulose film, sulphonated oils and others.

The Defense Production Administration has announced that the restrictions would have to be made because, despite increased production of sulphur, demand is running substantially ahead of supply.

New iron desulphurising process

A new process for desulphurising iron by the use of calcium carbide is now under development, according to Mr. John A. Hill, president, Air Reduction Co., Washington. Pilot-plant tests carried on by the company have established the commercial practicability of using carbide as a desulphurising agent.

Nitrogen output expansion

The National Production Authority has disclosed that 16 new or expanded nitrogen plants, with a total capacity of 620,800 tons yearly, are under way or planned for early construction. When these go into full production, they will raise total U.S. capacity of all types of nitrogen to more than 2,500,000 tons p.a.

Nitrogen-producing capacity totalled about 1,860,000 tons last January. The new production will come into being gradually over the next three years with the last facilities to start operating in the autumn of 1954.

New Kansas nitrogen factory

The new $16,000,000 nitrogen fertiliser plant, which it is proposed to build at Lawrance, Kansas, will be the biggest single project ever undertaken in the U.S. by the cooperative organisation. It will be built and operated by the Cooperative Farm Chemicals Association, a subsidiary of the Consumers' Cooperative Association.

From studies made by the Midwest Research Institute of Kansas City, it was estimated that mid-west demand for nitrogen would total about 260,000 tons annually by 1960, against the 1950 consumption of only 57,000 tons. One year's output of the proposed nitrogen fertiliser plant could, at present prices, add $75,000,000 to the value of a single year's maize crop in the mid-west.

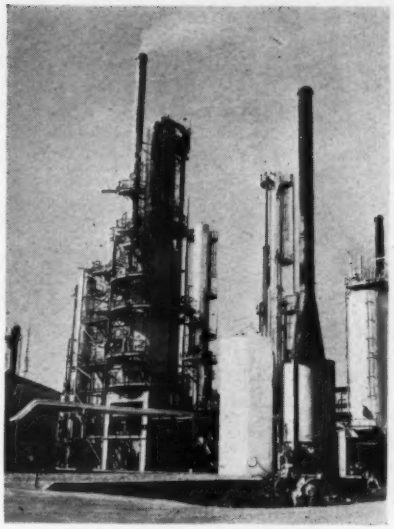
The Department of Agriculture is recommending that plants capable of turning out 700,000 tons of nitrogen fertiliser annually be placed under construction at once.

Gulf Oil's new units

The Gulf Oil Corpn. has awarded a contract for the design, construction and erection of a 125,000-barrel-daily atmospheric and vacuum unit for its Philadelphia refinery. The new installation, when completed in the summer of 1953, will be the largest single crude distillation unit in the world, it is claimed.

Gulf Oil has also announced plans to construct another sulphur-recovery unit in Texas in addition to the new sulphur unit at its Port Arthur refinery. The new 20-ton/day sulphur unit will be built at Gulf's Waddell petrol plant in Texas. Construction is scheduled to start next month and the plant should be in operation by next February. The company's sulphur unit at Port Arthur will have a 60-ton/day capacity.

The Waddell plant is at present processing about 38,000,000 cu. ft. daily of casing-head gas, from which some 45,000 gal. of petrol, 17,000 gal. of butane and 20,000 gal. of propane are produced daily. The new sulphur unit will remove hydrogen sulphide from the gas before the processing and convert it into sulphur. At present, the hydrogen sulphide is being vented and burned.



FLUID CATALYTIC CRACKER

This completed converter shows some of the construction of the world's first Orthoflow fluid catalytic cracker, recently put on stream at Edmonton, Canada for the British American Oil Co. Ltd. by the M. W. Kellogg Co. A small unit in comparison with other fluid crackers, this Orthoflow is designed to process about 2,000 barrels/day. The design, however, is not restricted to small throughput. In addition to the fact that the Orthoflow is a single-vessel unit containing chambers for reactions, regeneration and stripping, the most important innovation is the straight-line catalyst carrier lines which are within the vessel. The lines will be much less subject to erosion by high velocity catalyst than bent lines. Another economy and low-maintenance feature of the design is the elimination of expansion joints in the lines. To absorb the natural thermal expansion of the carrier lines the specially designed catalyst-and-oil-flow control valves are spring loaded. The valves themselves are a deviation from the slide valves which control the flow in the majority of fluid crackers erected to date. In essence, they are large needle valves through which catalyst and oil are introduced to the carrier line leading to the reactor. Hot catalyst from the bottom of the regenerator is drawn into the line by the pressure drop created by high-velocity oil passing through the valve. Another advantage claimed for the Orthoflow design is the elimination of much of the supporting structure.

Synthetic rubber target is 860,000 tons

Production of synthetic rubber in Government-owned plants is running at an annual rate of 760,000 tons, according to the Reconstruction Finance Corpn. Production will continue to be expanded until mid-1952, when an annual rate of 860,000 tons is expected to be reached. At the beginning of this year production was at an annual rate of 540,000 tons.

TO AUTHORS OF BOOKS. The editors and publishers of the Leonard Hill Technical Group are always prepared to consider manuscripts with a view to publication. All books published are assured of world-wide sales. Address such correspondence to the Chairman, Leonard Hill Ltd., 17 Stratford Place, London, W.1.

MEETINGS

Institution of Chemical Engineers

GRADUATES' AND STUDENTS' SECTION

December 6. Discussion on 'The Home Paper,' 7 p.m., Queen Hotel, City Road, Chester.

December 7. Film show and discussion on 'Oil Industry,' 6 p.m., Anglo-Iranian Oil Co. Ltd., Britannic House, Finsbury Circus, London, E.C.2.

December 8. 'Design of Bubble-Cap Distillation Columns,' by D. C. Freshwater, 6.30 p.m., Meeting Room 10, Chamber of Commerce, New Street, Birmingham.

December 14. 'Plant Management in Chemical Works,' by P. M. Shaw, 6.15 p.m., Chemical Engineering Department, Stephenson Building, Claremont Road, Newcastle-on-Tyne.

Society of Chemical Industry

December 7. London Section. 'Planning of Experiments in the Chemical Industry,' by G. Box, 6 p.m., E.L.M.A. Bureau, 2 Savoy Hill, London, W.C.2. Joint meeting with the Royal Statistical Society.

December 11. Chemical Engineering Group. 'Planning of Maintenance in Chemical Works,' by H. Birchall, 5.30 p.m., Burlington House, Piccadilly, London, W.1.

December 11. Agriculture Group. 'Alternative Phosphatic Fertilisers,' by T. P. Dee, Fisons Ltd., and Dr. Rice Williams, N.A.A.S., 2.30 p.m., Royal College of Science, Imperial Institute Road, London, S.W.7.

December 12. Road and Building Materials Group. 'Aspects of Heat Insulation,' by G. N. Critchley, 6 p.m., Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1.

December 14. Fine Chemicals Group. 'Glass Plant in Industry and Research,' by B. H. Turpin, Quickfit & Quartz Ltd., 7.30 p.m., Chemistry Lecture Theatre, King's College, Strand, London, W.C.2. The chemical engineering department of the college will be on view between 6.30 and 7.30 p.m., prior to the meeting.

December 19. London Section. Symposium on 'Radiochemistry,' by Sir John Cockcroft, Dr. J. E. Johnson and J. Smith, 4 p.m., Waldorf Hotel, Aldwych, London, W.C.2.

Chemical Society

December 6. 'New Developments in Methods for following Fast Chemical Reactions,' by Prof. H. W. Melville, 5 p.m., The University, Liverpool.

December 7. 'Scientific Problems in the D.S.I.R.,' by Sir Ben Lockspeiser, 6.30 p.m., Engineers' Club, Manchester. Joint meeting with the Royal Institute of Chemistry and the Society of Chemical Industry.

December 13. 'Recent Developments in the Chemistry of Free Radical Reactions

in Solution,' by Prof. D. H. Hey, 7.30 p.m., Burlington House, Piccadilly, London, W.1.

December 14. 'Industrial Utilisation of Agricultural By-Products,' by Dr. F. N. Woodward, 7.15 p.m., Department of Agriculture, Queen's University, Belfast. Joint meeting with the Royal Institute of Chemistry and the Society of Chemical Industry.

Royal Institution

December 14. 'Mechanics of Metal Crystals,' by Prof. E. N. da C. Andrade, 9 p.m., 21 Albemarle Street, London, W.1.

Institution of Mechanical Engineers

December 7. 'Measurement and Interpretation of Machinery Noise with Special Reference to Oil Engines,' by C. H. Bradbury, 5.30 p.m., the Institution, Storey's Gate, St. James's Park, London, S.W.1.

December 14. 'Problems of Fluids for Hydraulic Power Transmission,' by B. Cooke, 5.30 p.m., the Institution, as above.

Institute of Fuel

December 10. 'Control of Gas Turbines,' by E. H. Warne, 7.30 p.m., The University, Edmund Street, Birmingham.

December 14. 'Fuels derived from Coal Tar,' by Dr. D. McNeil, 7 p.m., Royal Technical College, Glasgow.

December 18. 'Carbonisation by the Moving-Burden Technique," by member of the staff of I.C.I. Ltd., Billingham, 5.30 p.m., Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.

Institute of Metal Finishing

December 17. 'Immersion Tinning of Steel by Internal Electrolysis,' by O. Wright and H. D. C. Rapson, Northampton Polytechnic, St. John Street, Clerkenwell, London, E.C.1.

Institute of Metals

December 7. 'Precious Metals in Industry,' by H. G. Dale, 6.30 p.m., the University, St. George's Square, Sheffield. Joint meeting with the Institute of Metal Finishing.

December 10. Symposium on 'Materials Testing,' 6.30 p.m., Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2.

December 12. 'Development of Aluminium Alloy Casting,' by A. P. Fenn, 7 p.m., Waldorf Hotel, Aldwych, London, W.C.2. Joint meeting with the Institute of British Foundrymen.

Liverpool Metallurgical Society

December 14. 'Metallic Coatings,' by D. L. Phillips, 7 p.m., Electricity Service Centre, Whitechapel, Liverpool.

Leeds Metallurgical Society

January 3. 'The Platinum Metals, their Properties and Uses,' by Dr. J. C. Chaston, 7 p.m., the University, Leeds 2.

British Paper and Board Makers Association

December 7. 'Treatment of Paper Mill Effluents,' by Dr. R. S. Jobin, 7 p.m., the Engineers' Club, Albert Square, Manchester.

January 4. 'Application of Chromatography to the Paper Industry,' by A. F. Williams, 7 p.m., Engineers' Club, Albert Square, Manchester.

Institution of the Rubber Industry

December 10. 'Factice: Its Use and Function in Rubber Technology,' by Dr. J. B. Harrison, 6.15 p.m., Engineers' Club, Albert Square, Manchester.

Manchester Statistical Society

December 14. 'Statistical Tests in the Comparison of Laboratories,' by D. H. Ward, 6.45 p.m., Albert Hall, Peter Street, Manchester.

Society of Dyers and Colourists

December 21. Discussion on 'Dyeing Machinery,' introduced by F. H. Marsh, Longclose Engineering Co. Ltd., 7 p.m., Midland Hotel, Manchester. Joint meeting with the British Association of Managers of Textile Works.

Society of Instrument Technology

December 21. 'High Vacuum Technique,' by J. Blears, 7.30 p.m., College of Technology, Manchester.

Hull Chemical and Engineering Society

December 18. 'Sindri Nitrogen Fertiliser Factory, the Establishment of a Heavy Chemical Industry in India,' by T. H. Riley, 7.30 p.m., Church Institute, Kingston-upon-Hull.

Institution of Works Managers

December 11. 'The Profession of Management,' by A. M. Hudson Davies, Fibreglass Ltd., 6.30 p.m., Adelphi Hotel, Liverpool.

January 3. As above, 7.30 p.m., Vane Arms Hotel, Stockton.

Silicone Chemistry

Prof. Rochow is a leading authority on silicone chemistry. While with the General Electric Co. in the U.S., he achieved the first successful synthesis of methyl chlorosilanes from methyl chloride and elementary silicon. This was a notable contribution, since it made possible the synthesis of silicones without using the hazardous Grignard reaction. He later built a pilot plant for the direct synthesis of methyl chlorosilanes. With this background he is well qualified to write the present book,* which has gone into a second edition within five years. The new chapters in the second edition are 'The Carbon-Silicon Bond' (chapter 2), 'Synthesis of Organosilicon Compounds' (chapter 3), 'The Physical Chemistry of Silicones' (chapter 7) and 'Tables of Physical Properties of Organosilicon Compounds' (chapter 11). Although originally it was not intended that the book should be used as a work of reference, it was seen that research chemists wanted to use it for this purpose, 'in spite of the stated and purposeful incompleteness of tables and references.' For this reason and in order to add thoroughness without losing the general approach, the tables of compounds and references have been organised as a separate chapter where they are classified and available for ready reference instead of being scattered throughout the book.

The book attempts a critical survey of the field of silicone chemistry and the new edition has benefited from the information made available by the comparatively recent removal of certain war-time and patent restrictions. Thus, factual support is given to many ideas which had been decidedly sketchy. Silicones are being increasingly used in industry and are being incorporated in oils, greases, rubber and protective coatings. Thus this book has a potentially wide readership and, by virtue of its chapter on production methods, will interest plant and process chemists as well as research workers.

**An Introduction to the Chemistry of Silicones.* By E. G. Rochow. 2nd edition. Chapman & Hall, London, 1951. Pp. 213 inc. index. 40s.

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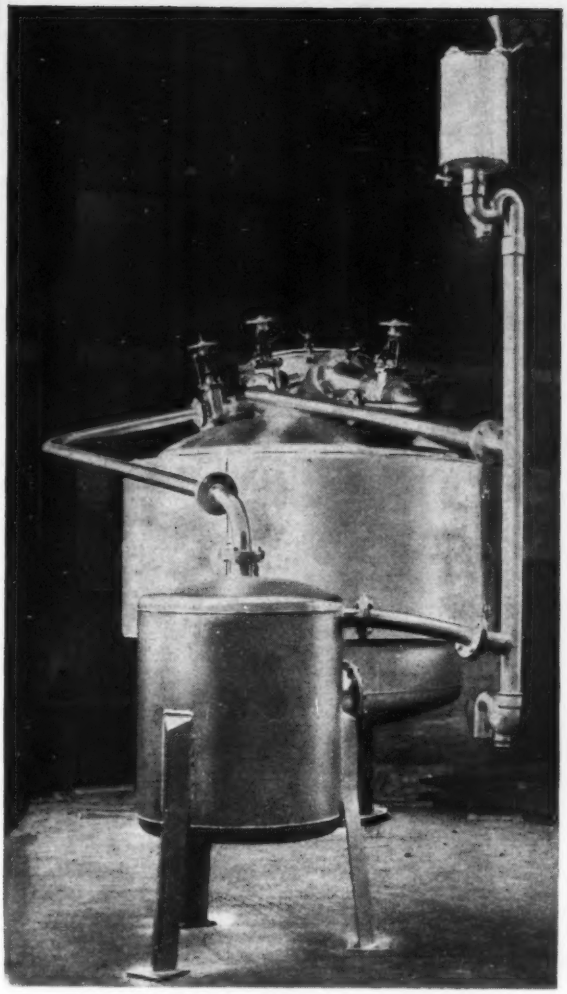

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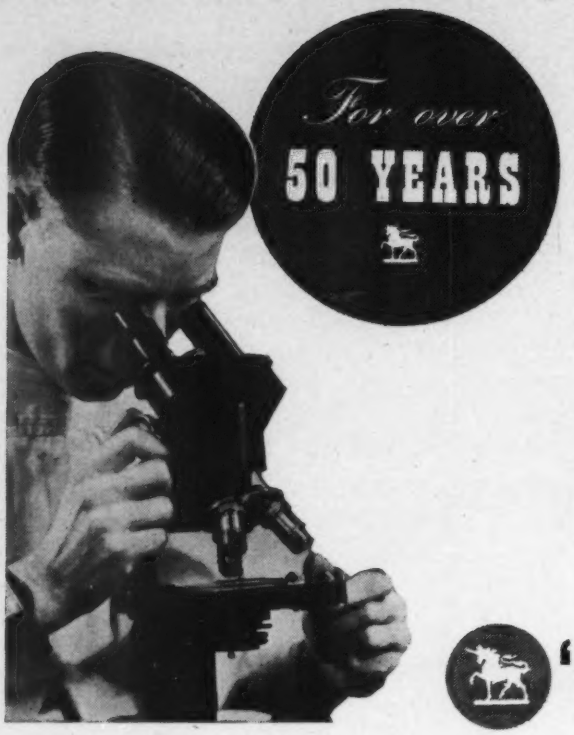

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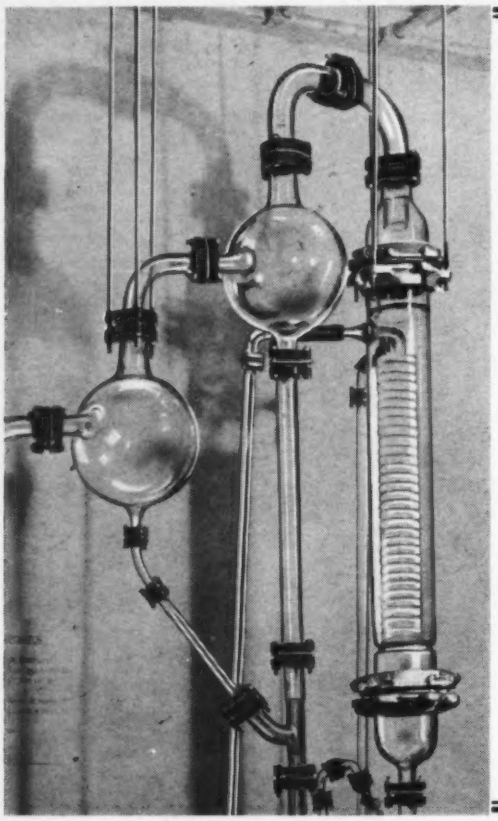

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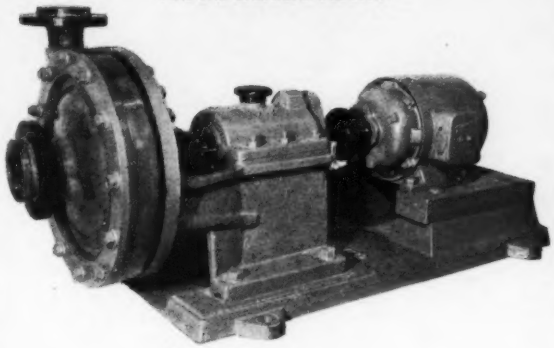

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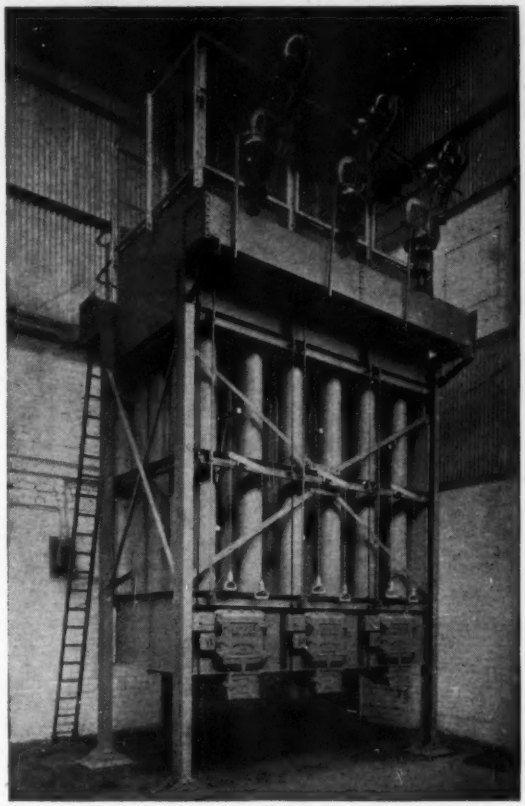

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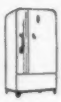

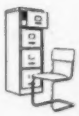

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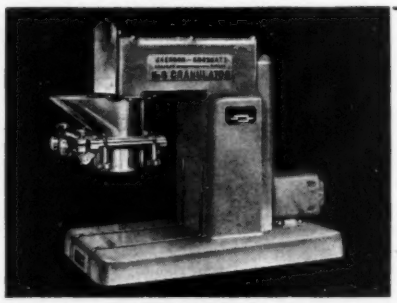

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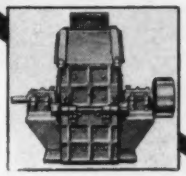

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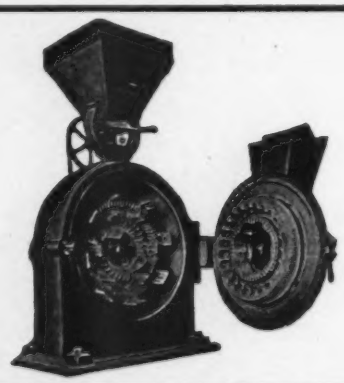

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